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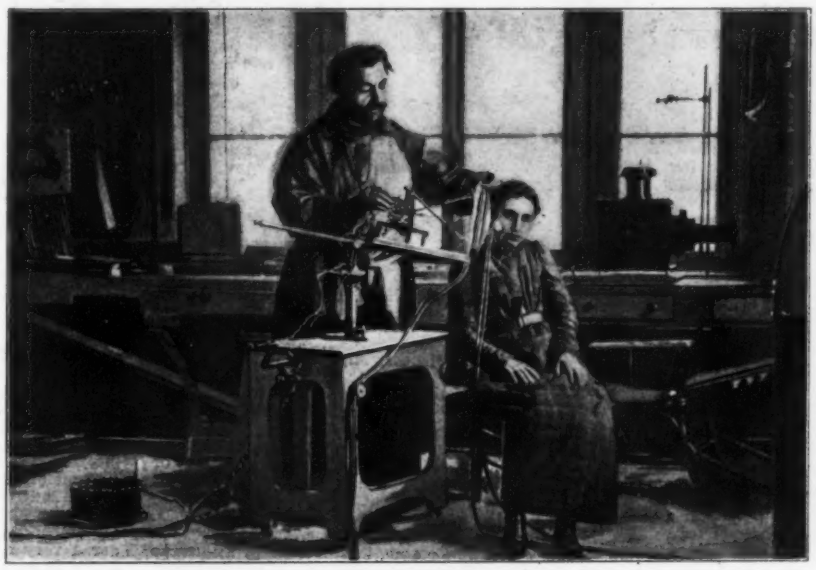
PHOTOTHERAPY.

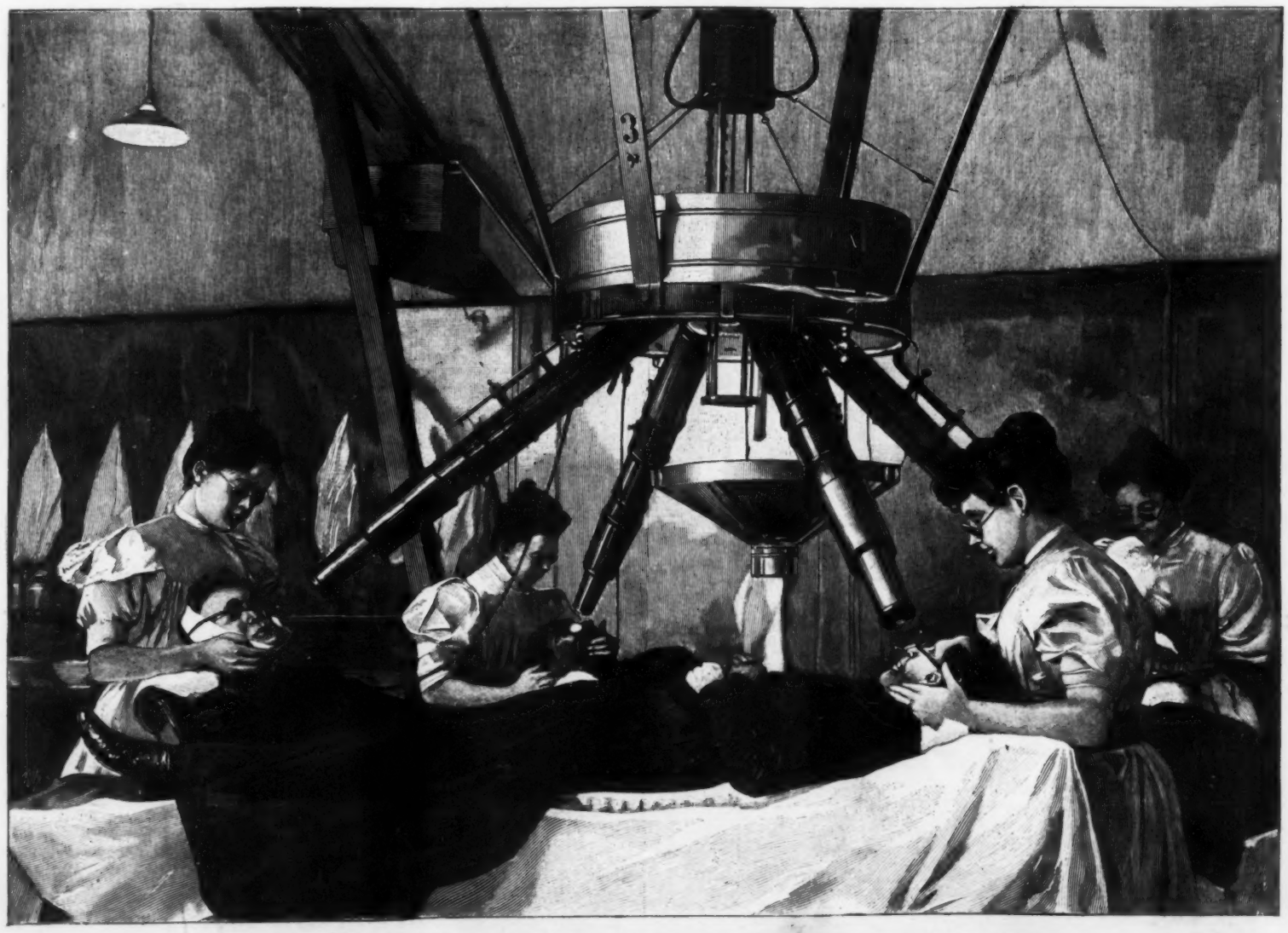
THE copious radiation with which the sun floods us, and which is the source of all life and activity, contains forces of infinite forms of which science has scarcely begun to avail itself. The elementary spectroscopic analysis of solar light, which the rainbow effects in nature, shows us that white light is composed of colored luminous radiations that give the visible gamut: violet, indigo, blue, green, yellow, orange and red. Beyond the violet, however, as well as beyond the red, physicists are daily discovering new radiations of wave lengths that are too great or too slight to be perceived by our eye, but the physical and chemical properties of which are very marked and hold in reserve for us many surprises.

The radiations at the red side are called calorific, because their action is shown especially by an elevation of temperature, and those of the violet side are called chemical on account of their action upon the molecular equilibrium of matter, which they tend to modify; or, in other words, on account of the chemical effects that they produce. It might therefore have been foreseen that a day would come upon which, through the dissociation of the elements of solar white light, it would be possible to obtain some curious effects, from a scientific viewpoint, as well as in the application of the sciences to the industries and arts, and even to the art of healing, according as the calorific radiations or the chemical ones alone were brought into play. We know that solar light, which is really the most universal, the most economical and the most active agent of salubrity on account of the rapid destruction of microbes produced by it, owes this property entirely to the disturbing action of its chemical radiations.



PHOTOTHERAPIC TREATMENT OF A PATIENT IN MM. LORTET AND GENOUD'S LABORATORY AT LYONS.

As early as 1859, Charcot gave out the opinion that it was the chemical rays that caused solar or electric dermatitis, or sunstroke; and, in 1862, Prof. Bouchard, in his researches upon the intensity inherent in each ray of the solar spectrum, from the viewpoint of the irritating action it is capable of exerting upon the skin, confirmed such opinion. Hence the idea that it might be possible in certain eruptive affections to diminish the irritation of the skin, even when such irritation proceeds as far as to suppuration. This idea is the origin of the treatment of smallpox by red light. In fact, upon allowing only the calorific radiations to reach the skin of a smallpox patient, we suppress the exciting and disorganizing action of the chemical rays, and, as a few experiments have demonstrated, the inflammatory effects of the eruption are reduced to a minimum. But a still further advance was made and the question asked whether it would not be possible to treat and cure certain skin diseases considered as parasitic, and microbian, by the exclusive use, on the contrary, of the chemical violet radiations, which are so active in the destruction of microbes. It is to Prof. Finsen, of Copenhagen, that is due the honor



TREATMENT BY ELECTRIC LIGHT AT THE FINSEN INSTITUTE, COPENHAGEN.

of having been the first to call the attention of the medical world to the benefit that might be derived from the phenomena above mentioned, and it is he who was undoubtedly the first to make a practical application thereof in laying the foundation of "phototherapy."

It is to Prof. Finsen that we owe the treatment of smallpox patients in rooms from which the chemical rays are excluded by filtering the light through thick red curtains or through glass of the same color. The method, moreover, has been applied also, with some success, to the treatment of measles. But several chronic skin diseases, too, have some relations to light as regards cause and progress. In the case of freckles, for example, the masses of pigment show themselves exclusively upon the parts of the skin exposed to the sun. Hence the indication to preserve such parts from the light. This is negative phototherapy. On the contrary, positive phototherapy would be indicated against skin diseases of a microbian nature for destroying the microbes that cause them. Lupus, which is a most horrible disease and very difficult to cure, has been the particular object of Prof. Finsen's experiments.

In practice, the professor, in order to concentrate the solar rays, uses hollow lenses filled with water colored blue by an ammoniacal solution of copper. This water filters the light, absorbs the calorific rays and allows nothing to pass but the chemical ones from which the therapeutic action is expected.

One of our engravings shows some patients afflicted with facial lupus undergoing treatment at the phototherapic institute at Copenhagen. The light employed here is not solar, but electric, the chemical spectrum of which is longer than that of the former. It will be seen that the patients have the eyes and healthy skin protected against the curative rays, the effects of which are strongly caustic.

Another engraving represents, on the contrary, a treatment in the open air by solar light. This may be called the empirical form of the treatment, and permits the patients to get the benefit of the tonic action of insolation upon the general system. It is a sunbath of localized action. The patient, enveloped in white linen and provided with black spectacles, is laid upon a cot with his head as high as possible and protected against solar radiation. The nurse having the subject in charge regulates the direction of the solar lens in such a way that the focus shall always be very near the part submitted to treatment.

Under such conditions, Prof. Finsen, up to the 31st of December, 1899, had effected 311 cures out of 462 cases of lupus treated. The other patients have had their treatment interrupted by various causes, and but four cases showed themselves refractory.

Nothing is more picturesque and interesting to behold in the garden of the Copenhagen Hospital than Prof. Finsen's thirty nurses clad entirely in white, their heads covered with white cotton caps, with wide rims, their eyes protected by large blue spectacles, and their arms entirely bare and browned by the rays of the sun, maneuvering the large blue lenses so as to cause the concentrated rays to fall upon the parts to be treated, which are outlined by the physician by a circle drawn with a dermic pencil.

There is no doubt that France will soon follow this example, since MM. Lortet and Genoud have introduced the Finsen method, and their experiments, performed at the Laboratory of Parasitology of the Faculty of Medicine of Lyons, have perfectly confirmed the results of the Swedish physician and have even exceeded their hopes.

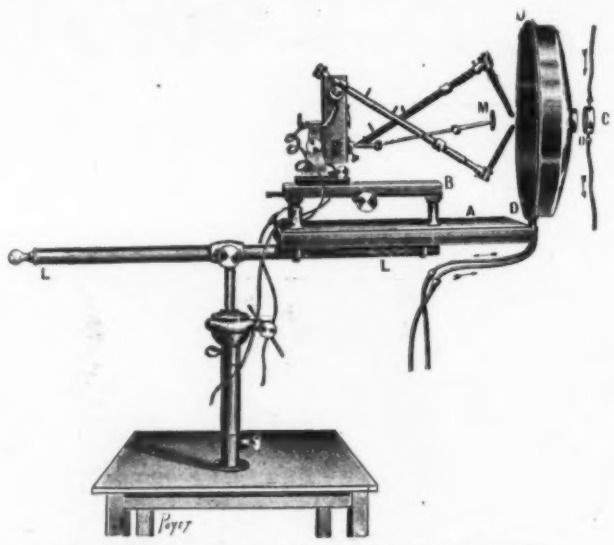
In a communication made on the 4th of last March to the Academy of Sciences, MM. Lortet and Genoud described an apparatus of their invention, the object of which was to increase the power of the electric rays by rendering them utilizable as closely as possible to their origin and to avoid their dispersion by doing away with the various conducting lenses. The apparatus is shown in action in one of our figures, in which is seen a young female patient under phototherapic treatment for a facial lupus. In another figure we give a view of the apparatus. The continuous current electric arc is produced between two carbons forming an angle sufficient to allow the crater of the positive one to project the greatest part of the light in a cone whose axis passes through the center of the orifice, *O*, which is situated in the center of *DD*, a sort of vertical basin with a double bottom, the walls of which, about a quarter of an inch apart, leave a space for water to constantly circulate in. This water prevents the heating of the basin, which acts merely as a screen and is provided with an orifice through which the light passes. A system of jointed arms and screws permits of the regulation of the arc, which may be brought to within variable distances from the screen.

When the apparatus is in operation the arc is brought to a distance of from one-half to three-quarters of an inch from the orifice. The carbons are concealed by the flanges of *DD*, and the small mirror, *M*, prevents any projection of light to the rear. The arc is therefore illuminating only through its anterior part in relation to *O*. In front of the orifice there is fixed a small apparatus, *C*, a sort of hollow shutter limited upon its two faces by disks of rock crystal. In the interior circulates a current of water.

The electric arc may be brought to within 2½ inches of the shutter without the latter becoming heated.

The apparatus is mounted upon a rod movable in all directions, so that the manipulation of it is rendered very easy. The time of exposure necessary in order to obtain a curative result does not exceed 15 or 20 minutes, instead of the hour and a quarter that was consumed with the apparatus previously employed.

Although MM. Lortet and Genoud are still in the



MM. LORTET AND GENOUD'S PHOTOTHERAPIC APPARATUS.

TREATMENT BY SOLAR LIGHT.

period of experimentation, numerous patients have already benefited by their laboratory phototherapic installation; and the first results obtained by them are sufficiently conclusive to allow us to hope to see hospitals and clinics adopt their methods upon a large scale.—L'Illustration.

PLANT OILS AS FOOD.

THE importance of fat as an ingredient in the human diet needs no restatement. Only too often, however, it is found that individuals who have most need for fats have not the slightest taste for them in the ordinary forms in which they are prepared for consumption, amounting in some instances to positive aversion. But in these cases fats and oils may be taken not only readily, but with positive pleasure. In the warm countries where the disinclination to animal fats is apt to be pronounced, the plant oils, such as olive oil and the various nut oils, are usually favorite articles of diet.

The possibilities latent in vegetable oils as an article of diet are not utilized, especially in this country, to an extent proportionate to their merits. Theoretically we may admit that plant oils are of the greatest nutritive value, but do not realize the practical importance of this fact.

Fat is a substance elaborated by cellular activity in living organisms. Whether the cell that accomplishes the production of the fatty material from indifferent elements, or collects it little by little from the nutritive material supplied to it, be plant or animal, the process and its result are biologically equivalent. The protoplasm of the plant cell is to all intents and purposes exactly the same as that of the animal cell. Analyzed, chemically, after the death of the cell, they are found to be made up of the same substances. It is no wonder, then, that the various products of their activity should resemble each other. Plant oils and animal fats have, it is true, certain characteristic qualities in which they differ from each other. Certain members of the plant series of fat compounds are, however, much more nearly related to certain animal fats than they are to other members of their own series; and, on the other hand, many animal fats resemble others of their own series much less than they do the plant oils. The more fluid fats contain a larger proportion of olein than do the harder fatty substances which are rich in palmitin and stearin. The yellow fats are richer in olein than are the white fats, which owe their color mainly to stearin. Human fat is much richer in olein than most other animal fats and for this reason approaches more nearly many of the vegetable oils.

Clinical experience has shown how beneficial for human consumption are the fish oils, which are also rich in olein. The product is, however, expensive and its preparation for table use requires most carefnl precautions, as it may have associated with it a number of undesirable substances that make it unpalatable and indigestible, especially for the delicate stomachs of the patients who most need it. The vegetable or plant oils are not open to these objections. Moreover, they can be obtained very cheaply. Modern manufacturing enterprise has made it possible to obtain certain of them in a perfectly neutral state, and much cheaper than even the ordinary animal fats. There seems every reason, then, that their use in the family should be encouraged as much as possible. They represent a most desirable addition to the domestic economy of the modern household, a cheap, clean, eminently nutritious and wholesome fat. This is especially fortunate at this time when fats are not being sufficiently used in the daily dietary.—The Medical News.

SWEETS SPARKLING WITH GLASS.

THE production of modern sweets is undoubtedly a fine art judging from the innumerable varieties made and the countless ways in vogue of making them attractive. At one time the most deplorable practice prevailed of employing such poisonous substances as chromium, lead, copper, or even mercury and arsenic, as coloring agents in sweets. Mainly, however, owing to the disclosures of The Lancet Analytical Sanitary Commission in 1854, the use of such objectionable coloring agents became happily obsolete, and, speaking generally, modern confectionery is now pure. According to our laboratory experience of recent years we have not found any objectionable ingredients of this character in sweets. True, the coloring agent is often an aniline dye, but so great is the tinctorial power of such dyes that it is probable that several pounds of the sweets would contain at most a few grains of the dye, and then the dye may be perfectly harmless. It is satisfactory to state that many sweets are colored with vegetable coloring, such as the chlorophyl of spinach, known as spinach-green, which is now made in large quantities for many commercial purposes. So far this account of modern sweets is satisfactory, but a somewhat unexpected and most objectionable method of manipulating sweets has just been brought to our notice. Sweets are made to glitter by means of splinters of glass, so that the sweet has the appearance of sparkling crystal sugar. We have in our laboratory at the time of writing some specimens of even high-class confectionery, said to be of French make, which all contain a liberal sprinkling of glass splinters. When the sweet is dissolved in warm water the splinters tumble to the bottom of the fluid into a miniature heap of broken glass. The splinters present both sharp points and sharp edges which are eminently calculated to cause an injury to the walls of the digestive canal. It is difficult to imagine a more powerful mechanical irritant than jags of glass which might easily cause laceration and hemorrhage, not to mention other disturbances such as are set up by foreign bodies less jagged than glass in the alimentary canal. The sweets to which we have referred were sent to us by a correspondent with a request for analysis, and he relates that these sweets were partaken of by two little children who shortly afterward suffered from severe abdominal pain, in the one case in the region of the appendix. The pain persisted for several days. The effect of sharp glassy particles lodging in the appendix could, of course, be easily disastrous. Our analysis enables us to say most positively that these glittering particles are glass. They are quite unchanged in boiling water or in boiling acids and melt into beads at a red heat. On analysis we obtained silica, lime, soda, and a little lead, which are the constituents of common glass. From their appearance on the sweets the flakes might easily be taken for gelatin or mica. The glass is probably prepared by crushing glass bubbles. It is said that the practice of employing glass in this way for decorating confectionery is extensively resorted to, especially by French makers. The sale of such sweets should render the seller liable to heavy penalties or, better, to incarceration, for broken glass may act exactly as an irritant poison and is most injurious to health. We trust that the local government board will give attention to this matter in order that the local authorities throughout the country may by means of the machinery of the Food and Drugs Act institute practical inquiries and stop the sale of such dangerous articles. It is probable that the practice is adopted in order to compensate for the absence of any crystalline appearance in glucose which is now so much used as a substitute for cane sugar in confectionery. In such a case the practice is not only monstrous because it is likely to lead to serious injury to health, but because it is a fraud also. Sanded sugar was bad enough, but to put glass splinters in sweets is diabolical.

COST OF ACETYLENE.

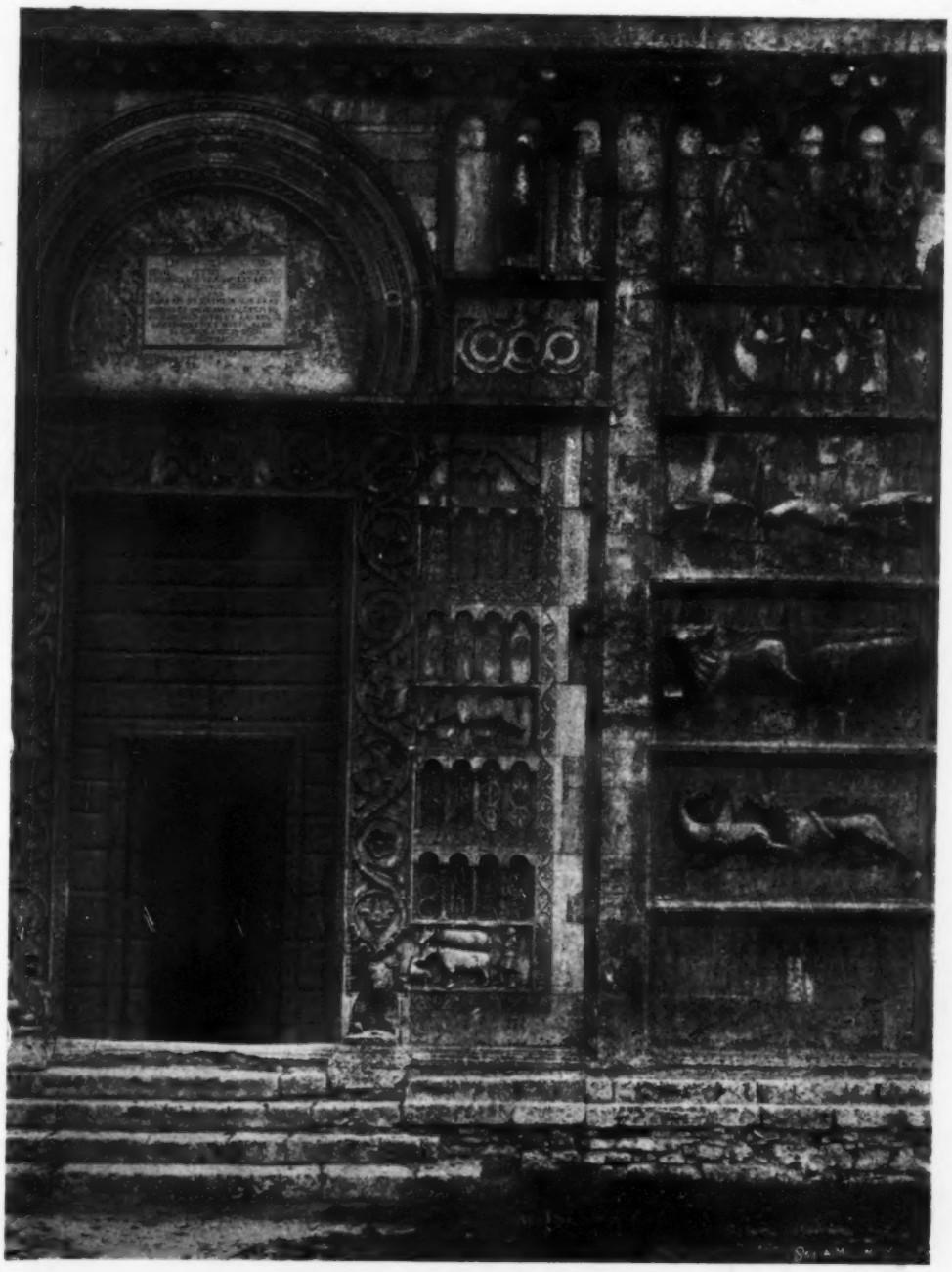
THE comparative cost of acetylene, per effective horse power, was fixed as follows, as the result of recent experiments in Berlin, says the Schweizerische Bauzeitung of January 26:

	Developed 10 H.P. cts.	20 H.P. cts.	30 H.P. cts.
Acetylene gas	5.85	5.62	5.54
Lighting gas	2.61	2.45	2.38
Power gas	2.90	2.19	1.95
Alcohol	4.04	3.86	3.81
Petroleum	2.56	2.38	2.32
Benzine	3.76	3.59	3.52
Electricity	3.60	3.55	3.46

These figures, given in United States currency, are based upon Berlin prices of materials, and include all the cost of installation, repairs and sinking fund. The figures represent the cost of an effective horse power hour in the three types of engines noted. Our contemporary concludes, as the result of these experiments, that after all the difficulties of construction and operation are solved, in connection with the use of acetylene motors, the relatively high cost of this motive force will be a serious obstacle to its industrial employment.—Engineering News.

A CURIOUS CHURCH IN SPOLETO.

SPOLETO is one of the most picturesque of all the Umbrian cities of Italy, situated as it is on a commanding hill. It was a well-known place in classical times, and Hannibal was repulsed by the Spoletans just after the battle of Thrasymene. The Lombards, A. D. 570, made Spoleto the capital of a duchy, which in time became entirely independent, and did not cease to exist until the twelfth century. Since the accession of the existing government, a quantity of new streets and a broad road winding uphill have done much toward removing the mediæval aspect of the town and have added greatly to its convenience. The crest of the hill is surmounted by the castle or "Rocca." On the other side of the castle, on a lower level, stands the cathedral, which is in the transition style. Here is buried Fra Filippo Lippi, who died in Spoleto while decorating the choir and apse of the cathedral. It was suggested to the authorities that it would be a graceful act to surrender the body of Lippi to the Florentines, and Lorenzo de' Medici was sent as an ambassador by the Florentines to reclaim the body of their great citizen; but his request was refused by the Spoletans because their city was "so poorly provided with ornaments, above all with distinguished men, and Florence, in her superfluity, might be content without this one." Accordingly the bones of Fra Filippo Lippi rested in Spoleto, and he was fortunate enough to have an epitaph by Politian.



FAÇADE OF S. PIETRO IN SPOLETO, ITALY.

A very interesting church in Spoleto is that of San Pietro, and we illustrate the detail of the façade. It was the original cathedral, and was dedicated to S. Brizio, who is buried there. The western front is most curious; between the square-headed doors are reliefs of monsters, men in conflict with lions, and angels and devils disputing over the dead. Above are cows and male figures in high relief.

This church is mentioned as existing in the fifth century, and it continued to be the cathedral until 1067, when the present cathedral was constructed. No

record remains of the date of the very curious façade, but the syle of its decorations, the rudeness of the workmanship, and the subjects which are introduced, give us reason to believe that this part of the building must have been added in the course of the twelfth century. By that time, bas-reliefs, in compartments, had been adopted; and at that time, knights in armor, and allusions to the Last Judgment, were commonly introduced as the ornaments of ecclesiastical buildings. In one of the bas-reliefs an imp has concealed himself beneath the balance, and is pulling down the unfavorable scale.

In the struggles between the Emperors and the Popes, Spoleto, by adhering to the latter, drew upon itself the vengeance of Frederick Barbarossa. It is not improbable that the Church of S. Pietro, which stood in an exposed situation, may have been one of the buildings which was injured on that occasion, and that the existing façade may have been added after the storm had subsided.

NEW ROTARY-SPEED INDICATOR.

THE accompanying figure illustrates an apparatus designed to register the velocity of rotation of any part of a machine having a circular motion. It is essentially based upon the action of the centrifugal force developed in an alternating circular motion, the period of which corresponds to one revolution of a wheel, or of the flywheel of the machine to be watched. A vertical directing rod, suspended from a horizontal axis, *O*, receives, through any piece whatever of the mechanism, the oscillating motion just mentioned, and which is of moderate amplitude. At the bottom there is a weight which is capable of sliding freely along it and is balanced by a spring, *R*. It is suspended at another part, *C*, from a beam movable around a horizontal axis, *I*, and is balanced by a counterpoise, *N*. A pendant rod puts the beam in connection with a liquid brake, *E*.

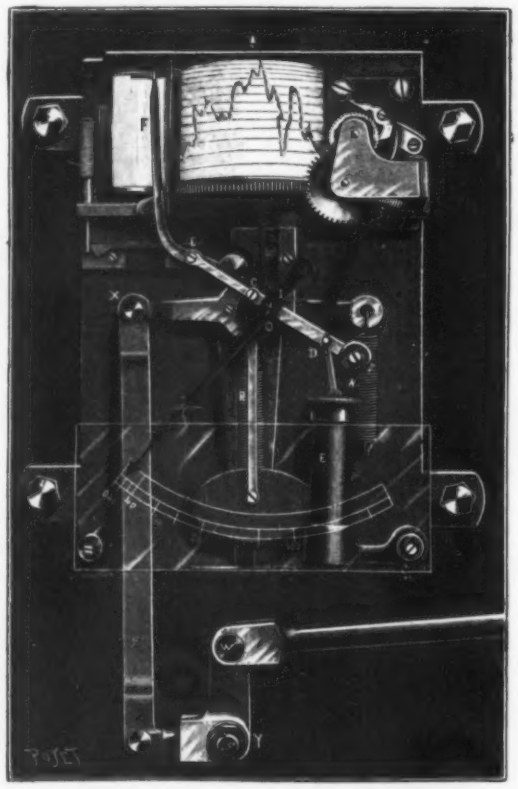
The rod, *O A*, receives an oscillating motion from the machine under experiment through the transmission, *X Z Y W*. In the weight, *M*, there is developed a centrifugal force which tautens the spring and causes the beam to incline. In each half-oscillation the value of the centrifugal forces varies from zero to a maximum, and inversely. Moreover, the oscillatory motion that the beam has a tendency to take on is opposed by the liquid brake, so that it is maintained in a stable position, the angular displacement of which is a result of the mean energy of the centrifugal force, which latter is shown by its giving a measurement of the velocity. Moreover, there is fixed at *I* a long needle which amplifies the motion and renders it easier to be seen by moving over the arc of a circle graduated into a number of revolutions per minute, or kilometers per hour, if it is a question of a vehicle of which the wheel diameter is known.

When constructed, the apparatus is graduated for a certain length of travel of the rod, *X Z*. As regards the graduated arc, its divisions are spaced farther and farther apart, the angular deviation of the needle, starting from *O*, being sensibly proportional to the square of the velocity. This does not prevent feeble velocities from being perfectly read. The oscillating nature of the motion assures extreme sensitiveness without the needle making abrupt jumps; this being prevented by the liquid brake. Moreover, it is possible to increase the scale for feeble velocities by transferring the pivoting of the needle to a second axis actuated obliquely by a rod connected with the beam, *I C*.

We have now seen how the measurement of the velocity is made manifest to the eye, but, as well known, instruments of this kind are thoroughly useful only when they leave a trace of such velocities. For this reason there has been arranged at the top of the apparatus a registering device consisting of a band of paper that winds around a drum with a continuous motion. One of the extremities of the beam, *I C*, carries a style that traces a curve of which the ordinates furnish the measurement of the velocity. Moreover, the revolution of the drum is assured automatically by the transmission of the indicator itself, through a ratchet, a gearing and a tangent screw.

The scale of velocities registered, like that of the dial, follows sensibly the law of squares. This scale is determined experimentally at the time of construction of the apparatus. The divisions corresponding to intervals of 10 meters are reproduced upon a sort of comb, which, mounted parallel with the axis of the drum, traces a series of parallel lines that permit of estimating velocities with the necessary exactitude at a glance.

We have not dwelt upon the source of motion that controls the indicator. The fact is that this is obtained from any part whatever of the mechanism that has an oscillating motion of invariable amplitude, or else through the intermedium of a false crank mounted



APPARATUS FOR REGISTERING ROTARY VELOCITY.

upon an axle. All that is necessary is a simple rod with a transmitting lever and a tension spring to suppress lost time and maintain the travel of the controlling rod, *X Z*, invariable. The regulation for any given machine is obtained through slight variations of the length of one of the arms of the lever, *W Y Z*, the joint of which is mounted upon a threaded rod.—La Nature.

A GAS BLOWING ENGINE.

WE illustrate a gas blowing engine which has been made and is now being erected near Wolverhampton by Crossley Brothers, Limited, of Manchester. The gas engine cylinders are placed on opposite sides of the crank shaft, and both connecting rods lead on to the same crank pin. The cylinders are 31 inches diameter and 30 inches stroke, and the engine makes 130 revolutions per minute. The blowing cylinders are each 63 inches diameter and 36 inches stroke. They are placed in front of the gas engine cylinders. Both pistons are coupled together, or, perhaps, to describe the arrangement more truly, the plunger of the gas engine cylinder is carried forward, and is bolted to the blowing cylinder piston. The air is compressed in the annular space thus formed between the back of the blowing-cylinder piston and the front of the gas engine cylinder. The engine is to be driven by blast furnace gas.

The valves on the blowing cylinder, which are made under Atkinson's patent, consist of a number of steel rings, 21 inches diameter, placed one above the other, and seating themselves on cast-iron seatings which are identical in form and piled one on top of the other. There are twenty-one valves and rings in each of the four groups, two being for the suction and two for the delivery. The steel rings have a lift of 3-16 inch only, and the air can pass both on the inner and outer edges of the rings. Large valve area is thus provided, and the small lift of the valves makes them exceedingly prompt and quiet in action and free from wear. The blowing cylinders deliver a total of 700,000 cubic feet of free air per hour, and afterward compress it to 7 pounds per square inch. By the removal of a cover and one central bolt, the valves and seatings can be readily taken apart for cleaning or examination; but, judging by the makers' long experience of the same type of valve, the necessity for this is not likely to occur frequently. Both the gas engine pistons and exhaust valves are cooled by passing water through them. The exhaust valves are also equilibrated by pistons almost of the same area as the valves, so that very little power is required to lift them, and the valve gear is relieved of heavy strains. The object kept in view in designing the engine was that it should be entirely self-contained and suitable for placing upon foundations which, from the nature of the ground, might not be stable.

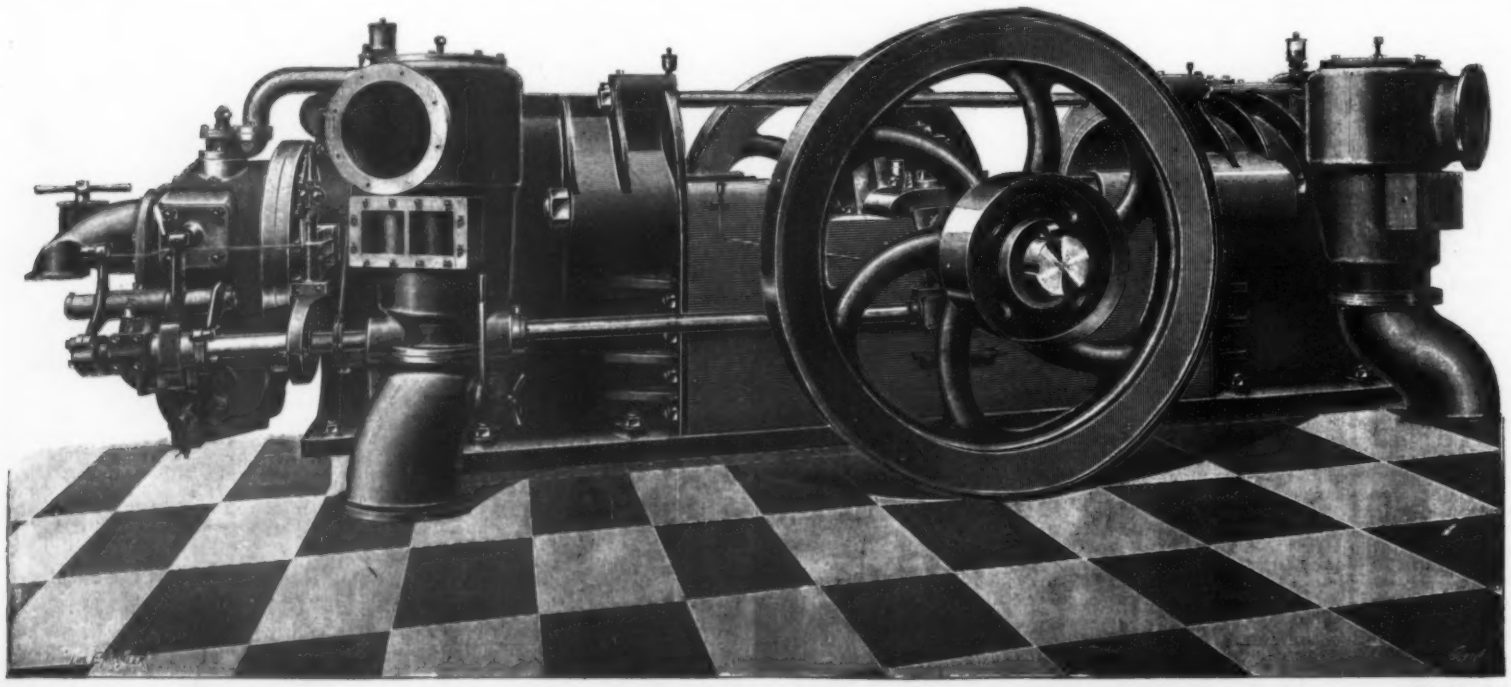
It may be added that, if necessary, this engine could work up to between 550 and 600 indicated horse power, and its total weight, when fixed complete, will be about 105 tons.—The Engineer.

INSTRUCTING TRAINMEN ON THE BOSTON ELEVATED.

IN preparation for the opening of the elevated line of the Boston Elevated Railroad from Sullivan Square, Charlestown, southward to Townsend Street, about five miles, which will take place within a few months, Mr. S. S. Neff, Superintendent of the elevated lines, is now instructing the prospective motormen in a school, elaborately equipped, which is doubtless the most complete establishment of the kind in existence. The trains on these elevated lines will have automatic air-brakes, and the road is to be equipped with automatic block signals, so that the school and its workings will be of interest to officers not only of street and city lines, but of all railroads, for the practice with both brakes and signals will be substantially in accordance with the same principles that prevail on standard railroads. On account of the frequency of trains the standard of efficiency required of the men will, of course, necessarily be the highest, so that an officer of the average steam railroad is more likely to find Mr. Neff's teaching of too high a grade than otherwise.

The equipment of the school, which is in a large room in the company's building at Sullivan Square, consists of two model cars, a large plan of the whole road, showing the signals, and a stereopticon and views to show on a large scale colored pictures of all the apparatus on the cars and all kinds of signals in every position. Hand-motion signals, according to the standard code of the American Railway Association, are also shown.

The 100 cars which will be put in service at the opening of the line are all motor cars. Each one has complete air-brake apparatus, and on each end has a controller, an engineer's brake valve and pressure gages and an emergency air-whistle. The main air reservoirs of all the cars of a train are connected together by a separate line of pipe, and equalized. The controller of a car, instead of acting directly, acts on an electrical apparatus, called a "throttle," which, in starting, automatically applies the power gradually, so that a careless motorman cannot possibly start a car too suddenly. Each car has a lever hanging down to near the level of the rail for automatically applying the air-brakes in



FIVE HUNDRED HORSE POWER GAS BLOWING ENGINE.

case a train runs past a signal indicating "stop," each stop signal being fitted with a trip for this purpose. The air-brakes can be "bled" from inside the car, as well as outside.

The plan of the road is drawn on a board, standing on its edge, about 14 feet wide and 7 feet high. Each signal blade is represented, in the proper place, by a miniature tin blade, properly colored, and about 2 inches long. This is pivoted so that it can be shown in either of its two positions, and it has a lamp, a very small incandescent electric, embedded in the board. The spectacle frames are fitted with properly colored translucent spectacles. The stereopticon views include pictures of every detail of car and signal equipment that a trainman can need instruction on, and the signals are colored.

With this board a pupil can be required to set the signals for any route, simple or complicated, and his understanding of the rules thereby effectually tested. A large number of men now employed as motormen on the surface street car lines of the company have already begun their studies in this school.

The signals, put in by the Union Switch & Signal Company, are the Westinghouse electro-pneumatic, and the rail circuit controlling them will be carried in one direction by a wire, one of the rails being required for the return of the power circuit which propels the cars.—Railroad Gazette.

"SHAMROCK II." STARTING IN TOW OF "ERIN" FOR THE SOLENT.

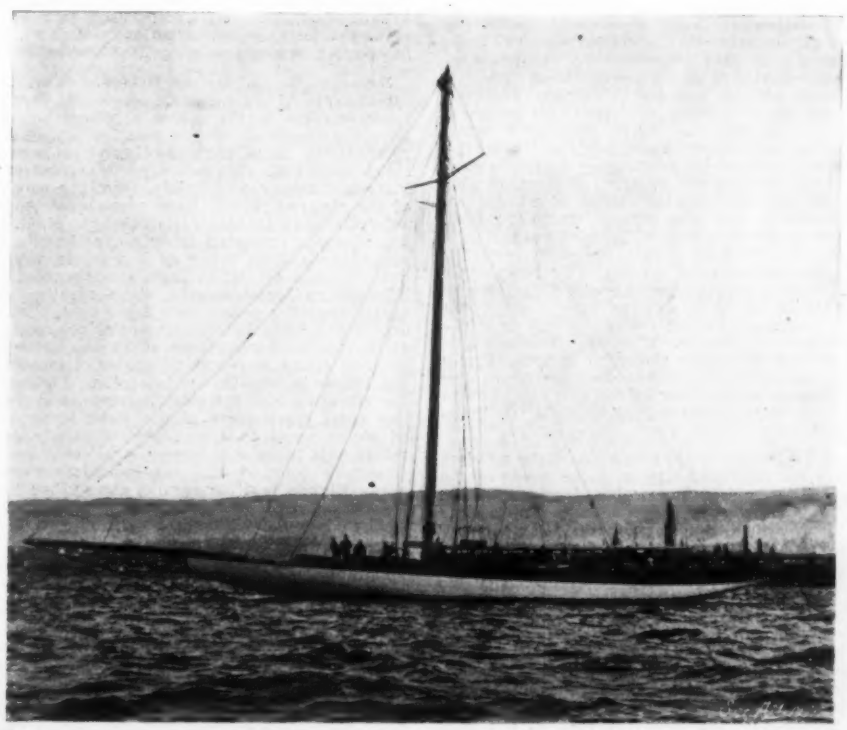
THE CUP CHALLENGER "SHAMROCK II."

IT was the general opinion among yachting men in Britain, as well as in America, that the chances of the first "Shamrock" in the America Cup races were reduced by the fact that she came to the line practically untried. So great is the anxiety of those interested in the new challenger to prevent a repetition of this error that an hour after she was handed over to them by the representative of the builders she started in tow of Sir Thomas Lipton's steam-yacht "Erin" for the Solent, for the purpose of bending her racing canvas and making an immediate start with the trials. The accompanying photograph was taken as she started, and it presents many points worthy of notice.

It will be observed that the bowsprit is considerably shorter than that carried by the Fife boat, and the length of boom which projects beyond the taffrail is also less than in the last challenger. The effect of these differences will be to give on a longer boat a shorter base line in estimating sail area for the purposes of rating measurement. The snubbed-off bow is also worthy of note, although the camera emphasizes the peculiarity somewhat unduly. Having none of her canvas aboard at the time the photograph was taken, the yacht is shown floating a few inches above the line to which she was designed to float, but even then the freeboard is considerably less than was ever given to a challenger. The topmast is shown housed by being telescoped into the mainmast, and the gaff when in position looks shorter than was expected.

It must be evident to the merest tyro in yachting matters that "Shamrock II." differs more from the American cup-defenders than they do from each other—that she stands, in fact, in respect of model, entirely a swallow. Indeed, it is evident that Mr. Watson was so satisfied with the performance of his most notable boat, the "Britannia," and with that of her lineal descendants, "Meteor" and "Sybarita" ("Valkyrie" was a departure from the typical Watson boats) that he decided to produce in "Shamrock II." a yacht of somewhat the same midship section, but with such changes in form as are called for by the longer overhangs, and such increase in sail-carrying capacity as comes from the substitution of bronze and aluminium for the heavy wood which was used for the skin and deck of the earlier boats. If there is any radical change in modeling it is in the fuller lines of the bow, of which we have heard so much, but which the photograph fails to show.

Another point on which previous calculations regarding the challenger would seem to be at fault is, as we remarked above, the size of the sail plan, which evidently is nothing like as large as that which will be carried by the two cup-defenders; and it certainly begins to look as though they would have to make a considerable time-allowance to the Watson boat. The value of this time-allowance will depend very largely upon the weather conditions which prevail during the contests. Judging from matches which have been sailed under the light winds which prevail off Sandy Hook in August, it would seem to be the best policy to crowd on the greatest possible amount of canvas; for a few minutes' time-allowance, one way or the other, as a rule, counts for little in races which occupy, say, five hours to complete. In fresh to strong winds, however, time-allowance becomes a most valuable feature, and with her wonderfully fine lines, "Shamrock II." may prove a formidable competitor under such conditions. In the current issue of the SCIENTIFIC AMERICAN will be found three photographs of the "Constitution" which, with the accompanying photographs of the "Shamrock II.," afford an excellent opportunity for comparing as much of the two boats as is seen above the water.



"SHAMROCK II." WITH RIGGING AND SPARS ABOARD, BEFORE THE SAILS WERE TAKEN ABOARD.

SEPIA.

THIS valuable brown pigment is the product of a ten-armed cuttle-fish (*Sepia officinalis* or *Sepia loligo*), which occurs in all European waters, but is common in the Mediterranean, and especially in the head of the Adriatic Sea, where it is used as an article of food. The animal is of a whity color with red spots, and possesses a sac containing a dark liquid, having an extremely high coloring power. This liquid it injects into the surrounding sea water when it desires to conceal its movements either from a prospective prey or from a dangerous enemy. The great efficiency of this liquid for the purpose may be inferred from the fact that it will render one thousand times its volume of water perfectly opaque. The effect is produced by the presence in the liquid of a black pigment, which is insoluble in water, but which diffuses through it. This pigment is in an extremely fine state of subdivision, and hence settles with very great slowness. It is insoluble in alcohol or in ether, as well as in water. It is known as melanin, or sepiaic acid, but its constitution is unknown.

The commercial pigment is prepared in the following way. As soon as the cuttle-fish is caught, the sac is extracted, and dried as quickly as possible to prevent putrefaction. The contents are dissolved in ammonia or in solution of caustic soda or potash (Guignet says in solution of carbonate or potash, but this is very doubtful), and the solution is filtered and reprecipitated with an acid. Either dilute sulphuric or dilute hydrochloric acid may be used, but, curiously enough, nitric acid will not effect the reprecipitation. The pigment is then washed with water till free from acid, and dried at a gentle heat. It forms then an impalpable dark brown powder which is perfectly permanent, except when constantly exposed to the direct rays of the sun. Its permanence as regards time may be judged from the circumstance that perfectly good pigment can be made from fossil cuttle-fish of the early secondary geological periods.

Sepia is used in the form of sticks as a sort of "Indian ink" in China, Japan and India. It is not suitable for use as an oil color, but it has been employed for water-color painting for very many centuries. It will mix with any other color, and it exceeds all other brown pigments in the ease with which a uniform coat of it may be applied with the brush.

Sepia, as it occurs in the market, appears to contain about 79 per cent of melanin, 10 of carbonate of lime, 7 of carbonate of magnesia, 3 of sulphates and chlorides of potash and soda and 1 of miscellaneous organic matter.

CONTEMPORARY ELECTRICAL SCIENCE.*

ATOMIC WEIGHTS.—It is now generally agreed that Prout's law that the atomic weights of the elements are exact multiples of the atomic weight of hydrogen, is decisively contradicted by experiment. The case of chlorine, whose atomic weight is 35.455, is in itself conclusive so far as the supposed law is concerned. But, as pointed out by R. J. Strutt, there remains the fact that many of the atomic weights approximate very closely to whole numbers, so much so as to suggest strongly that some law of nature is in question, as distinct from the action of chance. The author therefore carries out the interesting process of calculating the chance that the atomic weights should approximate to the whole numbers as closely as they do. Taking the nine best-known atomic weights—viz., bromine, 79.955; carbon, 12.001; chlorine, 35.455; hydrogen, 1.0075; nitrogen, 14.045; oxygen, 16.000 (standard); potassium, 39.140; sodium, 23.050; and sulphur, 32.065—the sum of the deviations from the nearest integral number is 0.809, or about 0.1 for each element. The probability of that occurring by chance is about 1 in 1,000, so that we have "stronger reasons for believing in the truth of some modification of Prout's law than in that of many historical events which are universally accepted as unquestionable." When a larger number of atomic weights are taken, the probability of chance is still smaller.—R. J. Strutt, Phil. Mag., March, 1901.

TELEGRAPH WIRES ON SNOW.—The fact that snow is a good insulator has been practically recognized by the employes of the Puy de Dôme observatory for a number of years. The double line which connects the observatory with the station of Rabanesse and with the telegraph office of Clermont is often interrupted during the winter season. The breakage is due to the fact that the poles, covered with a layer of hoar frost, which can attain a diameter of 3 feet, offer too large a surface to the winds, which blow with great violence. It often happens that in the execution of repairs the workmen drew a line of wire across the snow covering the Temple of Mercury, so that the wire was in contact with the snow over a length of 30 or 40 yards. Even when the poles remained standing, it often happened that their tops were covered with snow, and that quite 1,000 yards of wire were in immediate contact with it, without the messages being disturbed on that account. It might be urged that the best expedient would be to lay the wire always on the snow, as in the case of the Etna and Mont Blanc observatories. But on the Puy de Dôme the snow is not "eternal," and it is often either melted or blown away, leaving the bare rock.—B. Brunhes, Comptes Rendus, February 25, 1901.

SECONDARY RADIO-ACTIVITY.—The secondary Roentgen rays discovered by Sagnac have their counterpart in the secondary Becquerel rays studied by H. Becquerel himself. These were brought out by an interesting experiment. A leaden block 34 mm. long, 21 mm. wide, and 7 mm. high had a groove 1 mm. deep cut along its upper surface, and the groove was filled with a radium preparation of great activity. The block was placed on a sensitive plate for 48 hours, and the latter was then developed. A strong impression was found to have been made, in spite of the fact that the rays had to penetrate from 6 mm. to 20 mm. of lead. The rays, when filtered through the lead, were even found capable of penetrating two sensitive plates in succession and producing an impression upon a third. A peculiarity noticed by the author was that a strong geometrical impression was created where the under surface of the lead block had rested upon the plate, and that this impression was not eliminated by inserting a plate of mica. Small plates of any metal laid within reach of the rays, instead of weakening the impression by absorption, actually strengthened it by virtue of the secondary radio-activity produced, more especially at the edges directly exposed to the rays. Such secondary Becquerel rays have, however, very little penetrative power.—H. Becquerel, Comptes Rendus, February 18, 1901.

ELECTRODYNAMICS AND CRÉMIEU'S EXPERIMENT.—H. C. Pocklington deals with the threatened position of our present electrodynamic theory in consequence of the negative result of Crémieu's experiment (see The Electrician, March 8, p. 725). He carefully distinguishes between experimental facts and assumptions. The latter are four in number, and are as follows: The electric force satisfies differential equations; the magnetic force is connected with the electric force by a differential equation; the component in any direction of the electric force produced by a changing magnetic field is equal to the induced E.M.F. in an element of wire lying in that direction; and the motion of a body produces no motion in the ether through which it moves. The difficulty in the discussion of Crémieu's experiment lies in the fact that we cannot say with certainty whether a conducting envelope can, by screening off the electric force, reduce the magnetic force also to zero, or whether the surface of the wire in a coil can exert such a screening effect (either partial or total) on the substance of the wire. If a total or considerable partial screening cannot be shown to be theoretically impossible, Crémieu's experiment does not afford any decisive evidence of the want of truth of the hitherto accepted equations of electrodynamics.—H. C. Pocklington, Phil. Mag., March, 1901.

WIRELESS TELEPHONY.—The evolution of the wireless telephone is making rapid strides in the hands of the German physicists. E. Ruhmer, whose ingenuity seems to know no bounds, has modified both the transmitter and the receiver in a radical manner. After pointing out that a small current intensity in the "speaking arc" is bad for acoustic effects, but very good for the fluctuations of luminous intensity used for transmission, he proceeds to dispense with the arc altogether and substitutes for it a chalk or zircon block mounted on the telephone diaphragm itself and heated in the usual way by means of an oxy-hydrogen flame. The slight vibrations of the telephone disk suffice to alter the position of the luminous body in the flame, and thus to vary its luminosity in a manner suitable for the transmission of speech. At the receiving station, the high resistance of selenium cells has hitherto presented a difficulty. The author gets rid of it by substituting for the selenium cell a "radiomicrophone," a kind of carbon coherer mounted in the focal line of a parabolic mirror. The differences in temperature produced by the impact of the light upon the carbon are sufficient to actuate a telephone receiver. The author also suggests a bolometer as a receiver.—E. Ruhmer, Phys. Zeitschr., March 12, 1901.

EFFECT OF INVISIBLE RAYS UPON THE EYE.—The impression produced by Becquerel, Roentgen and ultra-violet rays upon the human eye has a certain fascination on account of its possible utilization in the case of blindness. Rays which penetrate opaque bodies may reach an optical nerve cut off from the outer world by turbid humors or integuments. F. Himstedt and W. A. Nagel have made a long series of experiments in this matter, but practically useful results are much interfered with by the rapid "fatigue" of the eye. After a few exchanges the subject is unable to say which of two packets, one filled with sand and the other with a radium preparation, contains the active element, though at first the latter produces a general luminosity in the eye. It appears certain that none of these rays produce fluorescence in the human eye, though they do in the eyes of some animals. Also, that it is the rods and not the cones of the retina that are chiefly affected. Geometrical impressions may be temporarily created in a blind eye by means of Roentgen rays transmitted through lead plates in which patterns are cut. A radium preparation produces a luminous sensation, which appears to proceed from the side on which the preparation is held. This is a hitherto unexplained effect.—Himstedt and Nagel, Ann. der Physik, No. 3, 1901.

DISTRIBUTION OF CURRENT OVER A CATHODE.—In exhausting cylindrical vacuum tubes containing circular cathodes nearly filling up the cross section, it is often noticed that the cathode and canal rays, which at high pressures fill up the whole tube, are gradually driven away from the walls until nothing remains but a thin pencil of rays along the axis of the tube. This observation suggested to A. Wehnelt that a considerable diversity should exist in the current intensity traversing different parts of the same cathode, and to find whether this was the case he constructed composite cathodes consisting of a central plate and a guard-ring round it. He found that in such cathodes the current only flows through the parts covered with visible rays. In the case of oscillating currents, it even happens that the guard-ring acts as an anode, while the central plate acts as a cathode. The cathode rays only proceed from those parts of a cathode from which luminous rays proceed also. When concave electrodes are used, the current density is the same on the inner and the outer surface. If two cathodes of equal area are contained in the same tube, the current flows mainly through the cathode showing the least drop of potential. Impurities have a great disturbing effect, but unevenness of the cathode only at high pressures.—A. Wehnelt, Phys. Zeitschr., March 2, 1901.

TELEPHONIC TRANSMISSION.—If human speech is to be transmitted with complete clearness, every constituent vibration must be reduced in intensity in the same proportion, if at all. That the telephone does not do this is due to the fact that the effective resistance increases with the frequency, while the magnetic induction decreases. This has a serious effect upon distinctness, especially as the frequency of the constituent sounds of human speech vary between such wide limits as 16 and 10,000 vibrations per second. Another complication is introduced by the natural period of the telephone disk. According to Max Wein, a Bell telephone reinforces the notes of 1,100, 2,800, and 6,500 vibrations per second, and several higher pitches as well. A Siemens telephone has two successive maxima at 5,000 and 5,400. The most characteristic notes of the human voice lie between 500 and 3,000, and for these notes the telephones of Bell, Apel and Siemens are equally sensitive. For higher notes, the sensitiveness often shows remarkable differences. Thus, a modern Siemens and Halske telephone will transmit the note 4,000 nearly 100 times as loudly as a Bell telephone. The author used an alternate-current siren for these investigations.—M. Wien, Ann. der Physik, No. 3, 1901.

METALLIC REFLECTION OF ELECTRIC WAVES.—Righi's experiments on the reflection of electric waves by metallic surfaces, in the course of which he claimed to have discovered an elliptic polarization of the waves by reflection, are of profound theoretical interest, especially since both Poincaré, from the point of view of Maxwell's theory, and Drude, from the point of view of the electron theory, have pronounced such elliptic polarization to be highly improbable. K. F. Lindman has therefore repeated Righi's experiments with improved apparatus, using as a wave-detector not the gapped silver deposit of Righi's, but a modification of Klemencic's thermo-couple. The results, whose accuracy excludes errors over 2 per cent, show that, in accordance with theory, plane-polarized electric waves of the order of magnitude of 10 cm. are reflected as plane-polarized waves at all angles of incidence, without losing perceptibly in intensity. The azimuth of the vibration also remains the same, and each of the two chief components of the wave suffers a change of phase equal to π. If any ellipticity exists, the minor axis is in any case so small that its existence cannot be detected with the indicators used. As regards Righi's positive results, the author is inclined to attribute them to disturbing reflections.—K. F. Lindman, Ann. der Physik, No. 3, 1901.

ALUMINIUM AS AN ELECTRODE.—The fact that an aluminium electrode in a voltameter allows a much stronger current to pass when it acts as a cathode than when it acts as an anode, has never yet been satisfactorily explained. It is not yet certain even whether the layer which produces the higher resistance consists of silica or of aluminium oxide. The recent researches of A. Bartorelli do not decide this question, but they give valuable information concerning the polarization and the internal resistance of the voltameter in terms of the current traversing it. The maximum polarization acquired by the voltameter when the aluminium is the cathode is a good deal smaller than when it is the anode, the figures being 25 volts and about 3.1 volts respectively. As regards resistance, it is found that for equal values of the difference of potential between the terminals of the voltameters, its resistance is always less with the aluminium as a cathode than in the opposite case. The ratio of the two resistances varies from a very small value at small E.M.F.'s to nearly unity at 25 volts. After both the polarization and the resistance have become constant, the current varies in a linear manner with the E.M.F., and a small increase in the latter brings about a large increase in the current strength.—A. Bartorelli, N. Cimento, February, 1901.

REFRACTION OF ELECTRIC WAVES.—By means of his modified radio-micrometer, G. Pierce has measured the refractive indices of paraffin, ebonite, and various specimens of wood. It will be remembered that in this apparatus the movable coil is traversed by thermo-electric currents produced by electric waves impinging upon a knot of fine platinum and platinum-nickel wire and heating up the junction. The measurements of refractive indices were made by observing the distance by which the interposition of a known thickness of the dielectric displaces the nodes of a stationary wave in air. The arrangement of apparatus for obtaining the stationary wave is essentially that of Lloyd's mirror for perpendicular incidence, the succession being radio-micrometer, oscillator, dielectric, and metallic mirror. The refractive indices of paraffin and ebonite for waves 4.4 cm. long were found to be 1.56 and 1.75 respectively. All the woods examined showed double refraction, black walnut, with indices 1.70 and 1.49 respectively, showing the largest divergence. The author shows from theoretical considerations that it is a case of true double refraction, and not an appearance due to differences of absorption.—G. Pierce, Phil. Mag., February, 1901.

SELF-INDUCTION IN WEHNELT'S INTERRUPTER.—T. Mizuno has investigated the effect of self-induction in a Wehnelt circuit, and has confirmed Ruhmer's theory as to the part played by self-induction in re-establishing the broken circuit. What plays the most important part after the break of the circuit in consequence of vaporization is the E.M.F. $L\frac{di}{dt}$ of the current at break. When this E.M.F. is sufficiently large to call forth the spark across the vapor, the current is re-established, because the vapor on the active electrode is thereby cleared off. Since the whole vapor is simultaneously condensed, the value of the current grows again according to Simon's equation, and the process of vaporization repeats itself. On the other hand, when the E.M.F. of self-induction is not sufficient, the spark cannot take place, and the current is greatly reduced by the presence of vapor which adheres to the surface of the active electrode. In the hammer interrupter, the spark due to the break must be absorbed by a capacity, whereas in Wehnelt's interrupter the insertion of a capacity in parallel stops its action. The author does not say how the spark at break "clears away" the vapor at the active electrode.—T. Mizuno, Phil. Mag., February, 1901.

MECHANICAL TRACTION IN PARIS.

THERE are certain difficulties in the way of employing mechanical traction in Paris that considerably restrict the freedom of the tramway engineer, and chief among these is the careful solicitude of the municipal authorities for the appearance of a city which has justly earned a world-wide reputation for its charm and attractiveness. Nothing must be done to spoil these qualities by unsightly installations or by vehicles which may cause annoyance and inconvenience to the public. The vehicles ought to be silent, unobtrusive, and inoffensive, and should fall in, as it were, with the general scheme of the city. The broad and spacious streets and avenues of which Paris has reason to be proud are sometimes blocked up with dense traffic, for a girdle of fortifications squeezes a population of two millions within a circumference of thirteen miles, and a quarter of a million vehicles of all kinds, of which a large proportion are big vehicles carrying heavy loads and constantly in circulation. The tramcarts should therefore be of great flexibility, and under perfect control; they should be able to start and stop instantly, and easily graduate their speed to the general traffic. On the right side of the river, to the north of the main boulevards, there is scarcely a street without a gradient, and the inclines are long and heavy in the neighborhood of Montmartre and the Buttes Chaumont, and the streets everywhere rise toward the outer boulevards. All the lines northward provide great resistances, which are enormously increased by the peculiar gluey mud which smothers the roads in damp weather. No satisfactory explanation has yet been given of the cause of the special consistency of this mud. It sticks to the rail, and when a car starts on an up grade the resistance to be overcome is enormous. On the level the heavy cars will sometimes slide several yards when all the brakes have been applied and the sand-box opened. These high resistances necessitate a considerable reserve of power. A tramcar which will fulfill all these conditions may be regarded as fairly perfect, and the companies, in attempting to solve this problem, have experimented with every possible system, with the result that Paris possesses a variety of tramcars such as is to be met with in no other city.

The question of laying down an efficient system of tramways has long been of special importance to a city like Paris, where, until the past decade, the transport arrangements were exclusively in the hands of the Compagnie Générale des Omnibus. This company was granted a monopoly of public transport in 1855 for a period of fifty-five years. Legally, therefore, it still enjoys a monopoly, as the contract does not expire until 1910. Until within recent years its vehicles consisted entirely of horse-drawn omnibuses and tramcars. The company has naturally aimed at economizing the working cost in every possible way, and as the city of Paris exacts a fixed tax upon every vehicle, whatever may be the size, the company preferred to run big omnibuses instead of a larger number of small ones. It economized the tax upon a certain number of vehicles while it seemed to provide the same ac-

*Compiled by E. E. Fournier d'Albe in The Electrician.

commodation for the public. This was one of the original causes of the conflict that has become so acute between the socialist Municipal Council and the omnibus company. This attempt to evade some of the burden of the tax has certainly resulted in the creation of an omnibus which is wholly inefficient to cope with the traffic. The vehicles, mostly drawn by three horses and aided by additional horses on the up-grades, are heavy and cumbrous, and have seating capacity for forty persons. They stop at certain stations, and are supposed to take up and set down passengers on the road, but as a matter of fact the passenger has usually to depend upon his own agility. The fares are thirty centimes inside and fifteen centimes outside, and for thirty centimes the passenger can claim a "correspondance" which entitles him to change vehicles on to another line, so that for this sum he can go from one end of the city to the other. This is undoubtedly an economy for people going long distances, but the minimum of fifteen centimes outside is not advantageous for those who have to travel short journeys. The public frequently agitate for the suppression of the "correspondance" and the fixing of a uniform fare of ten centimes, and the Municipal Council has tried to induce the company to carry out this reform, but the company always replies that it is willing to fall in with the views of the Council on condition of the monopoly being renewed. The omnibuses being heavy and of large capacity there is only a limited number on each line, and they run at considerable intervals according to a fixed time-table. The result of this state of things is that the public is kept waiting at the stations; passengers cannot take their places until an inspector is present to examine the "correspondances," and the complicated formalities tax the patience of the public, which is by no means improved as, during the busy hours of the day, the omnibuses pass full up, and people have to stand for a considerable time exposed to all sorts of weather. The system is thoroughly bad, and can only be remedied by running a larger number of light vehicles at frequent intervals. There is another drawback to these heavy omnibuses which is even more serious than their inability to deal satisfactorily with the traffic. The damage they do to the roads is incalculable. The wood or asphalt pavements in front of the stations are cut and broken up by the horses as they strain at the loaded vehicles, and in muddy weather the efforts of the horses to move their cumbrous burdens can easily be imagined. The cost to the town for road repairs must be considerably more than the economy secured by the company in the taxes upon their vehicles.

It was in 1872 that the first concession was granted for a mechanical tramway in Paris, but it was several years later that any serious attempt was made to introduce them on a large scale. The Compagnie Générale des Omnibuses fought the mechanical tramways tooth and nail. For a time it succeeded in intimidating the Municipal Council with its monopoly, and many of the concessions remained in abeyance because the authorities hesitated to sanction the construction of the lines. But this state of things could not last indefinitely. On the one hand the traffic was growing so rapidly that it had become extremely urgent to deal with it properly, and on the other hand the financial power of the company was becoming extremely objectionable to the socialist Council, which declared open war against the monopoly. The company was ordered to renew its stock so as to meet the growing needs of the public. The company was willing to do so if the Council would give an undertaking that the monopoly would be renewed. This was the last thing the Council intended doing. Opinion was unanimous that there should be no more monopolies, but the Council is even now undecided whether the public transport service will be taken over by the town at the expiration of the concession, or whether it will be worked by different companies paying a percentage of their profits to the town. As the majority favors the direct municipal exploitation of all public works it is probable that the Council will run the omnibus service on its own account. If it do, the outlook is not a brilliant one for the ratepayers. The Council has never shown up well as an executive body. No undertakings have squandered so much public money as the water supply and the drainage scheme, and whenever the Council takes up a new enterprise it is a foregone conclusion that its procrastination, its costly mistakes and experiments, will add enormously to the already heavy burdens of the town. So much money has been spent that it is becoming increasingly difficult to find a pretext to squeeze any more out of the ratepayers. As initiative is not a strong point with the French, the ratepayers have hitherto found themselves between the Scylla and Charybdis of monopoly and municipal exploitation, and they hardly know whether it is to their interest to submit to the exactions of the monopolies or pay through the nose for works carried out by the Municipal Council. The monopolies have had their day, and the Council is so pleased at its abilities as an executor of public works, as seen in the termination of the water and drainage projects, that it is anxious to try its hand at the manufacture of gas, and in running tramways and omnibuses. It will take over the gas monopoly in 1905, and will do the same thing with the omnibuses five years later. In both cases it poses as a public philanthropist. Gas is to be supplied at a little more than cost price instead of at thirty centimes a cubic meter as at present, and the omnibus system is to be entirely reformed. When the Council carries out a reform it is likely to prove very expensive to the ratepayers. Much better results would be obtained by making over the service to a company under the same conditions as is being done with the mechanical tramways. So long as the transport service is open to competition every company necessarily does its best to satisfy the public, and in the case of the tramways the service leaves nothing to be desired.

As the Compagnie Générale des Omnibus bid defiance to the Council and met every demand by a request to have the concession renewed, the Council decided simply to disregard the monopoly. In justice to the company, however, it should be remarked that it has a good grievance against the Council. Possessing a monopoly which is legally unassailable, it has been violently attacked by the Council, and all sorts of restrictions have been placed in its way for no other reason than that the municipal legislators are anxious to have everything under their control, and are goaded to think that a powerful monopoly can set them at defiance. Monopolies are as a red rag to a bull when they are held by other people; but the Council itself is extremely partial to the monopoly, which it hopes to get in its hands over every department of municipal work. If there were no party feeling in the matter the Council would doubtless have seen the wisdom of letting the monopoly rest until it expires nine years hence, the more so as the Council has little reason to complain of a bargain which brings it in something like 2,000 francs on each of the 1,100 odd vehicles owned by the company every year. Still the company itself is not blameless. Had it not carried on war against the Council from behind the ramparts of the law, and had shown a sincere desire to comply with the altered conditions of transport, it would have disarmed the city rulers, but instead of maintaining a conciliatory attitude, which was entirely to its own interest, the company persisted in standing on its rights until the Council decided to have nothing more to do with the company. The Council signified this rupture by granting a concession for the construction of a cable tramway at Belleville. The company protested, but found it was perfectly helpless to obtain satisfaction. Emboldened by its victory, the Council favored the various schemes that were brought forward for the creation of a vast system of tramways. It did not sanction these proposals all at once, for the Council hesitated a long time about facilitating transport between Paris and the suburban districts. It feared that the tramways would result in a migration of Parisians from the city to the suburbs, and in a corresponding diminution in property values and municipal revenue, but of late the measures being taken for the destruction of the fortifications and the abolition of the octroi have placed this question in the background, and it is to the mechanical tramway that credit may be partly given for this important movement. The increase in population has shown the necessity of providing facilities so that the working classes at least may be able to get away from the city and live under healthier conditions. The mechanical tramway has thus become a powerful instrument for social reform. As soon as the Council started upon its new policy of favoring tramway enterprise the Compagnie Générale des Omnibus bowed to the inevitable and accepted royalties from the companies which ran lines inside the city.

The immediate effect of these altered conditions was that the company found itself confronted by new and enterprising rivals who were employing mechanical systems which allowed of traffic being dealt with much more efficiently and more economically than was possible with the horse-drawn mastodon that had been doing service for half a century. Its position was becoming less satisfactory every year. Expenses were increasing in a much greater ratio than the receipts, alike through the mortality of the horses and the higher wages. The company, therefore, decided upon replacing mechanical traction on all its lines and seriously started upon carrying out a vast programme of this kind, but in view of the short time that still remained for the monopoly it would not go to the expense of laying down costly installations, but looked out for satisfactory systems of motor vehicles that would carry their own energy. Some years ago the directors sent out invitations to all the leading motor car builders asking them to submit plans for adapting propelling mechanism to the existing omnibuses, but as no satisfactory reply seems to have been received the company for the time being abandoned the idea of employing mechanism on their vehicles, though we understand that it is now experimenting with a steam omnibus upon the Purrey system. On the other hand, it has shown a good deal of enterprise in equipping the tramways with mechanical cars, and the first employed were the Rowan and Serpollet steam vehicles, and these were followed by the Mékarské compressed-air cars, and quite recently by Purrey steam cars and accumulator vehicles on the lines between Vincennes and the Louvre. Whether this partial transformation has been entirely successful it is difficult to say, for since the rupture with the Municipal Council the Compagnie Générale des Omnibus is preserving the greatest secrecy about the working of its lines. It will reveal nothing which may serve to enlighten the Council and strengthen its hands when the monopoly expires. Nevertheless, figures are available which show that during the four years from 1896 to 1899 inclusive, the increase in the number of passengers carried was from 135,379,000 to 140,363,000 by omnibuses, 95,355,000 to 97,449,000 by horse-drawn tramcars, and 15,305,000 to 36,691,00 by mechanical tramcars. The enormous increase in the last figure was, of course, due largely to the augmentation in the mileage of mechanical tramways, but a comparison with the returns for animal traction shows that the more rapid service has also a great deal to do with the improvement. The mere fact of the company being obliged to rely upon motor vehicles instead of employing electricity by overhead or surface contact, places it at a great disadvantage, and though the results are undoubtedly satisfactory on some of the lines, it seems as if the present directors are by no means disposed to devote any further capital for equipping their tramways with mechanical vehicles. They have been doing a great deal of costly experimenting, and their experiments have not always proved successful. At the next meeting of the company, it is probable that the Compagnie Française Thomson-Houston, which has taken up a considerable quantity of omnibus stock, will get some of its own directors appointed on the board, when another project may be presented to the Municipal Council for extending mechanical traction on the lines of the Compagnie Générale des Omnibus. This new development may possibly have a considerable influence upon the destiny of the company.

An idea of the extension which has taken place in mechanical transport will be gathered from returns recently published of the number of kilometers covered by different systems of tramcars on one of the Paris tramways during the five years ending 1899. The electric cars covered 952,000 kilometers in 1895 and 3,498,000 kilometers in 1899. The Serpollet cars augmented from 195,000 kilometers to 358,000 kilometers, but this latter figure was scarcely more than half the figure for 1897. The Lamm-Francq hot-water cars remained practically stationary, and fluctuated in the neighborhood of 600,000 kilometers. As for animal traction, the number of kilometers covered declined rapidly from 1,887,600 to 38,000, that is to say, the horse has been entirely replaced on this particular system by mechanical traction, except on a few small lines. In the same period the yearly profits rapidly augmented from 207,000 francs to 1,224,000 francs. One of the lines of the Tramways Sud was worked by animal traction from January to November 8, 1898, and the cars covered 330,401 kilometers, but from November 8, when the electrical service was inaugurated, to December 31 the total was 117,475 kilometers. In 1899 the distance covered by the electric cars was 1,371,029 kilometers. The passengers carried augmented from 2,943,121 to 9,737,460, and the total receipts increased from 343,980 francs to 901,202 francs, and while the line scarcely paid its way when working with animal traction it gave in 1899 a profit of about 360,000 francs. These figures apply to a period when the lines were still in an early period of transformation, and in 1900 no fewer than 109 kilometers of mechanical tramways were opened in Paris and in the department of the Seine, and sixty-six new concessions were granted.—The Engineer.

THE COMMERCIAL USES OF PEAT.

THE difficulty in obtaining coal for industrial purposes, and the high price that has had to be paid for it recently, especially where works are situated at long distances away from the mines, has led to more attention being paid to the use of peat for fuel. In the "Notes" of May 31, 1900 (vol. lxii., p. 108), a short description was given of the uses to which peat was being applied in Austria in the manufacture of textile fabrics. In a recent number of The Engineer (February 8, 1901) an account was also given of the peat fuel industry in Sweden. It is said that there is hardly any question of the day so prominent in that country as the use of peat fuel as a substitute for coal. The government, recognizing the importance of this matter, has appointed a Crown Peat Engineer, at a salary of £500 a year, to survey the principal Crown peat bogs and to report upon the quality and suitability of the peat for use as fuel in locomotive engines. At several of the large works in Sweden peat is now used for generating steam. At the great Yungtell Metal Works and the Motala Shipbuilding Works, it is also used in generating furnace gases, the fuel being prepared by specially constructed works. At the former establishment, engines of 230 horse power are supplied with steam generated by this fuel. In the province of Smaland a syndicate has recently purchased the peat bogs, from which it is estimated that a million tons of fuel will be produced in a year. At the Karpalund sugar refinery peat is now solely used for the nine boilers in use there of 100 horse power each; the fuel being first converted into gas in generators in front of the boilers. This establishment has purchased an adjacent bog containing sufficient peat to supply the works for twenty years. The bog is connected with the factory by a Decauville railway. The furnaces were formerly fed by coal obtained from England, and a very great saving has been effected, the peat fuel costing less than half that of coal. On several of the railways peat is being tried as fuel for the locomotives with every promise of permanent success. There are several different kinds of machines for making this fuel. The process something resembles brick-making. The turf is cut from the bog either by manual labor or machinery, and stocked in summer to be air-dried, any remaining moisture being removed in heated drums or by centrifugals, and the peat is then compressed into briquettes. It is claimed that one ton of dried peat from the best class of bogs is equal to half a ton of English coal.

The largest area of peat in England is to be found in the Fen district, where it covers 600 square miles and the depth varies from 2 to 10 feet in thickness, and at Whittlesea Mere as much as 18 feet. Nearly the whole of the peat in the Fenland has been drained and is now cultivated.* In a few places in the Fens it is sun-dried and used for fuel. In the form of powder and mixed with carbolic acid it is also extensively used as a deodorant for earth closets and similar purposes, works for this purpose being established in Cambridgeshire.

There are also large deposits in the East Riding of Yorkshire along the valleys of the Trent and Ouse, Hatfield Chase covering 12,000 acres, where a manufactory has been for some years in existence for drying and preparing the peat for litter for stables and cow houses. Its antiseptic properties make this litter very valuable, especially in large towns where straw is difficult to obtain. There are also large areas of peat in other parts of the country, as at Chatmoss in Lancashire and on Dartmoor.

In Ireland, the peat bogs cover about 5,000 square miles, or about one-seventh of the whole country; some of the bogs are 43 feet deep, the average thickness being 26 feet. Occasionally, owing to an excess of water, the peat overflows the basin in which it is contained and flows over the cultivated land. Thus a few years ago the bog near Tullamore overflowed and covered nearly three square miles of land. Sun-dried peat is used in Ireland to a considerable extent for fuel. Some attempt has been made to work it for commercial purposes. The Irish Amelioration Society some years ago encouraged the conversion of it into charcoal, but the process was not found to pay commercially, although peat charcoal is well adapted for working and tempering iron for the finer kinds of cutlery. The Irish Peat Company erected extensive plants for drying and distilling the peat and producing tar, illuminating oil and paraffin. At these works, one ton of peat yielded 10 gallons of tar, or 28 pounds of illuminating oil and 1 pound of paraffin.†

One of the last volumes of the Encyclopédie Scientifique, published in Paris,† is devoted to a treatise on peat and peat bogs. It describes the conditions under

* "The History of the Fens of South Lincolnshire." (London: Chapman & Hall.)

† "La Tourbe et les Tourbiéres, par Alb Larbalétrier. Encyclopédie Cientifique des Aide Memoire." (Paris: Masson et Cie.)

which peat was originally formed, the plants of which it is composed, the chemical analysis of its constituents, the principal bogs in Europe, the age of peat as deduced from the remains of animals, flint implements and tools found buried in it, the methods of obtaining and preparing peat for commercial purposes, the uses to which it is applied and its calorific value and antiseptic qualities.—W. H. Wheeler, in Nature.

A PRIMITIVE FRAME FOR WEAVING NARROW FABRICS.*

By OTIS TUFTON MASON, Curator, Division of Ethnology.

INTRODUCTION.

THE textile art among savage and barbarous peoples, as well as in the hands of country folk in civilization, consists in the joining of flexible materials in filaments—straw, splints, threads, etc. The simplest of these activities is twisting or twining. The making of sennit or braid comes next. After that will follow basketry, matting, netting, lace work, and even fabrics, all made, out and out, with the fingers.

The second step in the textile art, as in all others, will be taken with the aid of some kind of device which hastens or perfects the operation of the hand. There will be knives to split the material, gages to replace the finger nail, spindles, bobbins, frames, and shuttles, of very humble structure, forsooth, but all of them containing the working principles of the most advanced apparatus having the same functions. Omitting all other textile processes, attention will be directed here to weaving proper, or the use of mechanical appliances to this end among primitive peoples.

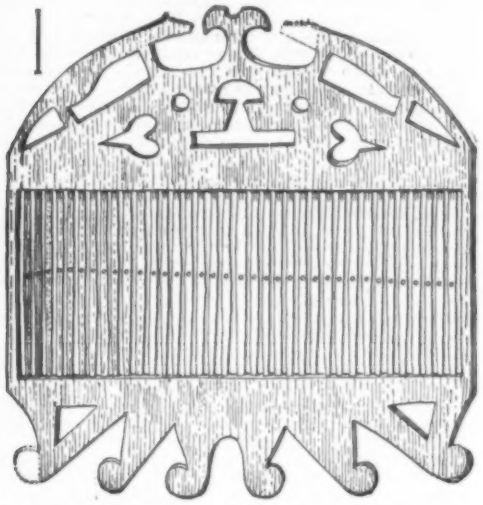
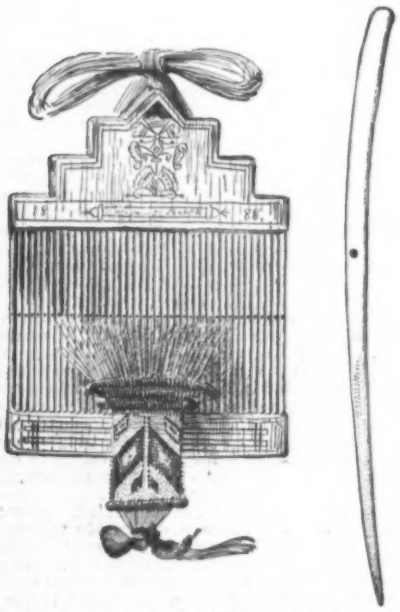


FIG. 1.—CHIPPEWA HEDDLE FRAME, CARVED FROM A SINGLE PIECE OF WOOD.



FIGS. 2 AND 3.—MASQUAKIE HEDDLE FRAME AND SHUTTLE.

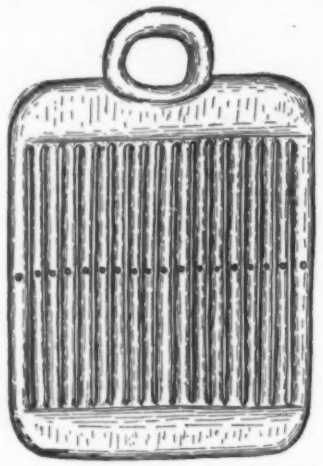


FIG. 4.—HEDDLE FROM HELSINGFORS, FINLAND.

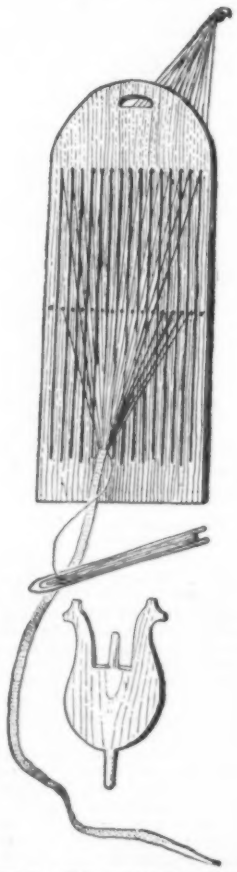
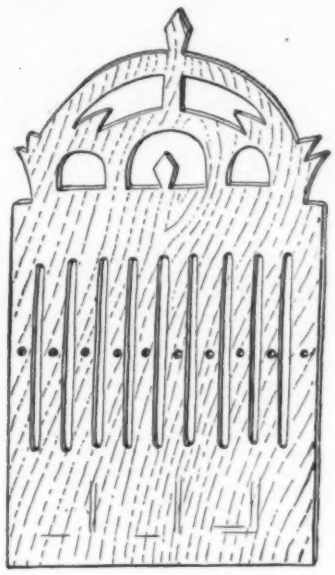


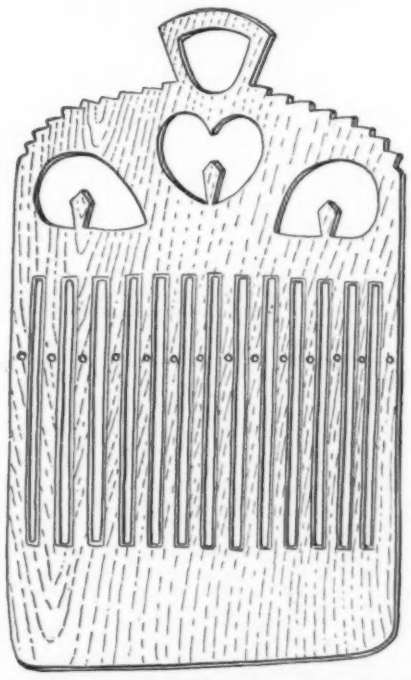
FIG. 5.—HEDDLE AND SHUTTLE, SET UP FOR WEAVING, ALSO WARP HOLDER.

Saalfeld, East Prussia.

In any style of mechanical weaving, however simple or complex, even in darning, the following operations are performed: First, raising and lowering alternately different sets of warp filaments to form the "sheds;" second, throwing the shuttle, or performing some operation that amounts to the same thing; third, after inserting the weft thread, driving it home and adjusting it by means of the batten,-be it the needle, the finger, the shuttle, or a separate device.

In the modern power loom the parts by which these operations are performed are very intricate and rapid in their composition and action; but in the simplest form of apparatus, from which the power loom was originally derived, a few sticks and strings and the cunning hand of the operator take the place of machinery, and time is no object. A careful examination of any power loom will demonstrate the oft-repeated fact that most of the machinery, after all, is a substitute for the human fingers.



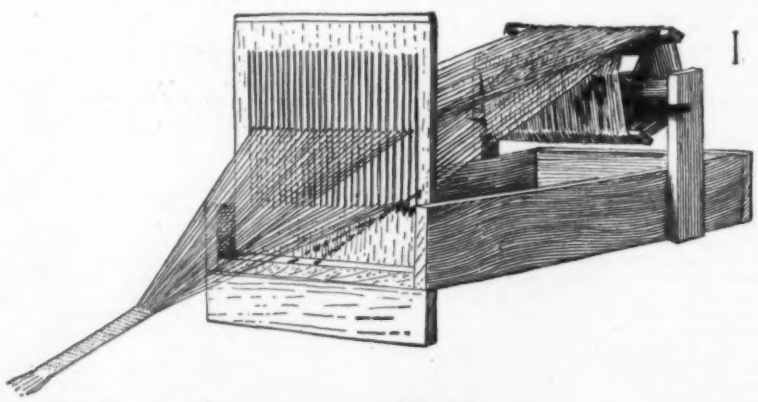


FIGS. 6 AND 7.—HEDDLES FROM STETTIN, NORTH GERMANY.

In Museum of the Society for Pomeranian Antiquities.

DEFINITION OF HEDDLE FRAMES.

There are in the U. S. National Museum a collec-



FIGS. 8 AND 9.—HEDDLES FROM SIENA, ITALY, AND LANCASTER, PENNSYLVANIA.

Set up in a box, with yarn beam and other loom attachments.

* From Report United States National Museum for 1899.

tion of heddle frames, and photographs of others from different parts of Europe and America, each one of which was designed to form the "sheds" in weaving belts and garters—that is, to raise or lower different sets of warp filaments in the manner to be now described. A series of healds are attached to or form parts of a heddle frame, which sometimes hangs free on the warp threads, and sometimes is attached solidly to a frame or box, or to the body of the operator. In the former of these classes the "sheds" are opened by the weaver, who lifts or lowers the heddle with the hand. In the second class, the "sheds" are formed by raising or lowering the inner ends of the warp itself, half of its filaments being entangled in the stirrups of the healds, the other half passing up and down between the healds.

A still simpler style of making "sheds" may be seen in a Chinese device employed in weaving rush matting. A block of wood like a piece of studding, as long as the matting is to be wide and 4 inches square in section, has a series of triangular saw cuts through it. Each cut has an upright opening on one side and terminates with a small hole on the opposite side. The next saw cut alternates with the preceding, its long opening on the side of the small perforation in the other cut. In rocking the heddle block by means of two handles on top, backward and forward, "sheds"

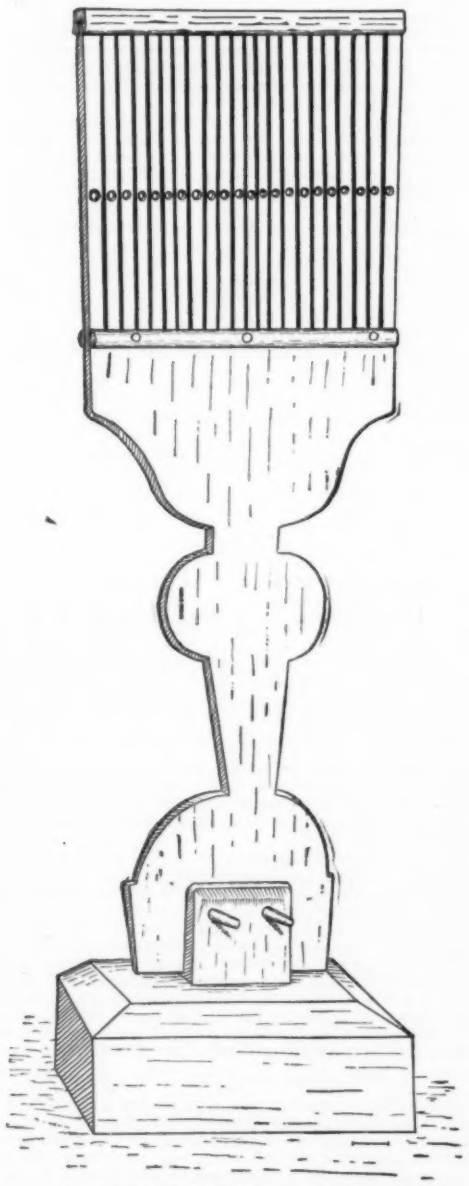


FIG. 10.—HEDDLE FRAME FROM BRISTOL, CONNECTICUT.

On solid base connected by an ornamental leg.

are formed in the twine which constitutes the warp of the matting.

The specimens to be herein described came to the museum from the Zuñi and other pueblos of the Southwest; from the Masquakee or Sauks of Iowa; from the Chippewa Indians; from Finland, Germany, and Italy in Europe; and, finally, from the English settlements in the New England States and New York, and the Dutch settlements in Lancaster County, Pennsylvania. To complete the round this ingenious mechanism, having traveled through many lands and some centuries, emerges from the U. S. Patent Office as patent No. 334,320, and adapted forms are used for illustrating technical instruction in the Teachers' College, New York.

HEDDLE FRAME OF THE ALGONQUIN TRIBES.

The first of these objects brought to the notice of the ethnologist, belonging to the first class above described, in which the operator raises and lowers the heddle frame, was a Chippewa specimen figured in Schoolcraft, but no description of it is there given (Fig. 1).

The Chippewa Indians (belonging to the Algonquin family) about Lakes Michigan, Huron, and Superior, were in an excellent area of food supply, contiguous to Iroquoian and Siouan tribes, and were also brought into close industrial relationship with the French explorers and priests; later the English settlers became their teachers.*

The very object described by Mr. Schoolcraft was in the possession of the United States Government before the U. S. National Museum was founded, and is here figured; but there is on the specimen and in the catalogues no allusion to the distinguished ethnologist and none to the function of the apparatus. It is carved from a single block of beechwood one-eighth of an inch thick. The upper margin is rounded and cut into patterns as with a jig saw, representing two animals, two hearts, and a symmetrical pattern in the middle. The lower margin is treated in the same way, only the designs are such as might be seen on old-fashioned

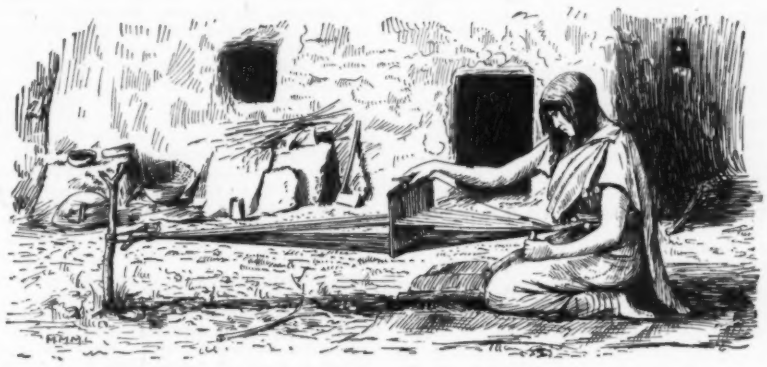


FIG. 11.—PUEBLO WOMAN SITTING ON THE GROUND AND WORKING HEDDLE IN WEAVING A BELT.

furniture. The working part of this apparatus is the rectangular space constituting the middle portion. There are thirty-seven upright healds or "heddle dents" and thirty-eight spaces. The healds are not inserted into the wooden frame, but are a part of it, and are about the twenty-fourth of an inch in thickness, the material having been cut away on both sides so as to leave these as thin as safety would allow. Each heald or upright piece is wider in the center than at the ends and is there perforated with a small hole. The whole frame is just 7½ inches wide and the healds about 3 inches in length. The points to be especially noticed in this example are, first, that the apparatus is made from a single piece of wood; second, that the Indians of the upper Great Lakes were taught by the early settlers from Europe to be weavers; and third, that the method of ornamentation, shown at the top and bottom of this specimen, is common enough in Germany (Figs. 6 and 7), but it is not common elsewhere among American aborigines on such heddle frames. The healds and spaces, together seventy-five in number, make provision for seventy-five warp threads in all.

Mr. W. J. McGee, of the Bureau of American Ethnology, calls attention to similar heddle frames in use among the Masquakee, or Sauks and Foxes, an

FIG. 12.—ZUÑI WOMAN WEAVING CEREMONIAL BELT.

Algonquin tribe in Iowa, and presents to the U. S. National Museum an excellent example of a weaving frame from that tribe (Fig. 2).

Mr. W. H. Jackson says that the Sacs, Sauks, Saukies, or Osaukees, as it has been variously written—a word meaning yellow clay—and the Foxes, or Outagamies, or more properly the Musquakkink (red clay) are now as one tribe. They were first discovered settled about Green Bay, Wisconsin (after residence on the north shore of Lake Ontario), but their possessions extended westward, so that the larger part was beyond the Mississippi. They partly subdued and admitted into their alliance the Iowa, a Dakota tribe. By 1804 they had ceded all their lands east of the Mississippi and settled on the Des Moines River, moving subsequently to the Osage (in Kansas) and, after 1842 [in 1845], the most of these finally to the Indian Territory. In 1822 the united bands numbered 8,000, but are now [1875] reduced to a little more than 1,000, of whom 341 are still in Iowa, 430 in the Indian Territory, 98 in Nebraska, and about 200 in Kansas. The Sauks and Foxes of the Mississippi in the Indian Territory have a reservation of 483,840 acres.*

The frame is made of walnut and is in its general structure similar to the foregoing, but is much heavier and more elaborately finished. It has forty-two healds, making provision for eighty-three warp threads in all. The ornamentation, at the top especially, has been evidently under the influence of whites in quite recent times. In this specimen, as it is set up, the healds are not all used, only a sufficient number to enable the weaver to form a texture having fifty-five warp threads. Especial interest attaches to this piece of work, which is an example of transparent weaving and beadwork. The warp consists of fifty-five white threads. The shuttle is a steel needle threaded with fine cotton on which beads of different colors are strung. The figures are produced by counting off the beads and arranging them so that one will fall in each of the interstices of the weaving.

Accompanying this frame (Fig. 3) is a shuttle for mat weaving, having an eye near the center of its body. In forming the beadwork a steel needle was employed; but in ordinary garter weaving on the same loom the shuttle was employed both for placing the weft and beating it home.

The general method of operation in both heddles just described and in all others of this type was as follows: Warp threads of the healds and spaces, or a smaller number, were cut into the length of the intended garter, or belt, or band to be woven. If they were all of the same color one filament was drawn through the stirrup in each heald and one passed between each pair of healds. If there were to be various colors in the warp, filaments of different shades were passed through the stirrups and between the healds according to the taste of the weaver. At one end, which will be called the outer or farther end, the filaments were gathered together into a knot and made fast to some fixed object answering to the yarn beam of a loom. The other end, which will be called the inner or proximal end, answering to the cloth beam of a loom, contained that portion of the fabric which, when finished, was rolled on a stick that lay against the breast of the weaver and was secured by a strap passing around the body and buttoned to the ends of the cloth beam. Some-

* Information respecting the Condition and Prospects of the Indian Tribes of the United States, Philadelphia, 1852, II, pl. 77.

* Report United States National Museum, 1885, p. 37.

times the inner ends of the warp were merely held in the left hand of the weaver. In any case, they were secured to some movable object which allowed the weaver to increase or decrease the tension at will.

THE PUEBLO HEDDLE.

There is among the Zuñi Indians a style of setting up the warp of a belt or garter for heddles of this class, which relates the frame to the Indian blanket loom. The warp is one continuous yarn wound round and round two cylinders, one resting against the soles of the weaver's feet, the other attached to her body by a strap which passes behind her back, its ends buttoning over the ends of the inner cylinder. In the use of this device the warp is loosened or tightened by moving the feet or inclining the body, the most pliant, delicate, and responsive tension device.* (Fig. 12.)

When the woman and her loom apparatus were set up for work, she raised or lowered the heddle with one hand. The warp filaments which passed through the stirrups in the healds, being fixed in their places, were by this movement raised or lowered with the frame, but the alternate threads which passed between the healds remained steadfast and straight. Whether the frame was raised or lowered, a "shed" was formed in the warp; the weaver then passed through this "shed" a simple bobbin or shuttle, often a rod with the weft woven on it, after the manner of a kite string, containing the weft or woof filaments, usually of white thread and quite fine. When the weft had been passed through this "shed" between the heddle frame and the body of the weaver it was beaten home by means of the shuttle or with a separate tool, as among the Zuñi, or by the weaver's fingers. This completed one weft.

The alternate warp series were then brought to the top or depressed, and a second "shed" formed. The shuttle was passed back through this "shed" and the weft again beaten home. If the pattern was to be wrought, the shuttle was not passed through the "shed" as described, but worked, as in darning, through a certain number of the upper warp threads each time before a new "shed" was made.

THE FINLAND HEDDLE.

In 1893, Consul-General John M. Crawford sent to the U. S. National Museum, from Helsingfors, in Finland, two specimens of this type of heddle, one of which resembles in general features those described, while the other (Fig. 4) is very suggestive of the type found in the pueblos of southwestern United States, to be later studied. Fig. 4 has eighteen healds in all and seventeen long slits between them. The specimen is 8 inches long and 5½ wide. The upright bars are whittled into a roundish shape, so as to present no sharp corners to the work. The top of the framework is carved out into the form of a ring used both in handling the apparatus and for suspending it when out of use.

With these frames were a number of belts and garters woven in such apparatus, which exhibit in their patterns the manner of producing diaper effects on the surface. In plain weaving, it will be recalled, the shuttle is passed backward and forward on the "shed" produced by the vertical motion of the heddle, and as soon as the weft is passed the shuttle becomes a batten for driving it home. But whenever the weaver desires to produce other effects than plain weaving, it is necessary to count off from the upper threads at each excursion of the shuttle such numbers of warps as are necessary, and to use a batten stick or her fingers in forming the secondary "shed" and in driving home the weft. This custom also appears in other places, to be mentioned farther on. Attention is especially called to the fact that along with this type of heddle in the Crawford collection there came a loom for weaving coarse hemp cloth. This apparatus coincides precisely with the common hand loom seen over Europe and the United States. Just as in New England and in New York the country folk were making cloth and tape with primitive apparatus only a generation back, so in Finland the same practices yet survive. Helsingfors lies at the northern end of the Baltic Sea, and it is only a short journey thence to northern Germany, where the little heddle frame will next be found. It doubtless traveled northward, acquiring a new name at every landing, but its structure and function have undergone little change. The patterns at Helsingfors are more primitive.

GERMAN HEDDLE FRAMES.

The next example takes the student to the town of Saalfeld, Königsberg, in east Prussia. It was presented to the U. S. National Museum by Mrs. Elizabeth Lemke, who says that it is a common apparatus among the people. There are twenty bars or healds in this example, and nineteen slits between. The frame is 14¾ inches long, and 8¼ inches wide. The healds are 8¾ inches long, giving to the warp thread a wider excursion up and down. This specimen is made from a thin pine board finished in a planing mill, and is three-eighths of an inch thick, without ornaments. The upper part is rounded and has a projecting handle, as in old-fashioned school slates.

The shuttle is of hardwood and resembles the form of a netting needle which has a deep, rectangular notch at one end and a slitted point at the other end opening into an eye, in the middle of which stands a pointed spindle. This specimen, like all those before mentioned, hangs free on the warp, and the "sheds" are made by moving the heddle up and down while the warp is stationary at both ends.

Example No. 176,321, in the U. S. National Museum, is also from Saalfeld. It is made of a thin piece of plain board, and there are sixteen healds and fifteen slits or spaces between the healds. The apparatus is 19¼ inches long, 8 inches wide, and nearly one-half an inch thick, rounded at the upper end, and cut out to form a hand-hold or grip. The saw cuts are roughly made, and the holes have been burned through with hot wire.

The shuttle is a small seine needle, not slitted at the point, but having a projecting spindle in the eye at the pointed end and a deep notch in the other, as in the common seine needle. In this example the shuttle contains white weft thread or twine; the warp filaments are alternating brown, blue, white, and red threads. The shuttle serves also for a batten to beat the weft in place.

Accompanying this apparatus is a device used in winding off the warp and giving to its filaments the correct length (Fig. 5). It is a piece of hard wood, heart-shaped, with a pointed base to fit in a socket and a pointed spool above to hold the yarn.

In the Museum of the Society for Pomeranian History and Antiquities, in Stettin, are three heddles or weaving boards of the type now being considered. Each was collected in further Pomerania, where the apparatus is called the "deska," as it is also known in Cassubisch dialect. It is in use up to the present day, but among the surrounding German population throughout the whole of Pomerania, so far as information goes, it is unknown. The oldest one (Fig. 6) measures 4 inches in width and 7 inches in length, is carved out of a single piece of wood, and has nine long openings between the healds which, through many years of use, have become worn away. These openings or slits are 3 inches long and 0.2 inch broad. There are ten perforations for warp threads, the outer two being through the sides of the frame itself. The upper margin of the board is cut out in figures or patterns quite similar to those on the Schoolcraft specimen. In addition to these openings, the surface is covered with carvings.

The second example (Fig. 7) is rather rudely made of board. It is 5 inches broad and 8 inches long. Counting the sides of the apparatus, there are fourteen healds, perforated in the middle, through which warp threads pass, and thirteen slits or openings between these, all 4½ inches long and 0.2 inch broad. The upper part of the board has three heart-shaped perforations, a serrated border, and a loop, used for moving the heddle up and down or for hanging it up when not in use.

A third example, having no ornamentation, is 5½ inches long and 8 inches broad. It has eighteen openings, 4 inches long.*

The lack of definite information concerning the precise origin of the Schoolcraft specimen (Fig. 1) and that of the Sauk or Masquakie Indians of central Iowa, collected by Mr. W. J. McGee, makes it difficult to inquire into the German origin of the Algonquin specimens. It must be noted, however, that the ornamental carvings at the top are alike in the two types. Furthermore, it must not be assumed that the specimens in the U. S. National Museum exhaust the geographic distribution of this type of apparatus. Quite the contrary. It would be surprising to find that it had no use in England and France in the Colonial period.

ITALIAN HEDDLE FRAMES.

In the U. S. National Museum is a heddle frame from the town of Siena, south of Tuscany, Italy, collected by Dr. G. Brown Goode. Unfortunately, material is lacking in all the area between east Prussia and Tuscany. Furthermore, it will be seen that the inventor has been at work more than once to transform the Cassubisch into the Tuscan specimen (Fig. 8). It consists of eleven strips or healds of walnut wood 5½ inches long, one-fourth inch wide, and one-twelfth inch thick, each perforated in the middle for a warp filament. These slats are set into grooves in a rectangular frame 6½ inches long and 5 5/16 inches wide; the frame itself is three-fourths inch wide and five-sixteenths inch thick. It accommodates twenty-three warp filaments and belongs to the second class of heddles before mentioned, in which the heddle is stationary and the weaver raises and lowers the inner end of the warp. This specimen is set up, with considerable mechanical accompaniment, on one end of a box that is 7¾ inches long and 5¼ inches wide. On the other end is an upright frame in which works a revolving yarn beam, a feature copied from the ordinary hand-loom.

There is also in the U. S. National Museum a facsimile of this example, from Lancaster, Pennsylvania, the center of the Teutonic population called the Pennsylvania Dutch. The framework, or heddle frame, has thirty-one healds or upright bars, perforated, and thirty-two slits, in all accommodating sixty-three warp threads of various colors. The ordinary yarn beam is replaced in this example by a reel, on which the warp is distributed. This reel is held fast by a stick pushed through between the spokes of the reel and resting against the upright posts which support the shaft. By removing the stick additional warp may be unwound (Fig. 9). Still more rude is another example in the U. S. National Museum, probably from Pennsylvania, consisting of a heddle frame cut out of a thin piece of board one-eighth inch thick. Provision is made for twenty warp threads by means of ten healds and ten slits. On one margin of the frame the outer portion is perforated and on the other side it is not. This upright is nailed in the end of a very rude box, having a bottom and two sides but no ends. The box is 2 feet long. At the rear portion, on either side, a post is fastened, and in this a reel, on which the yarn is wound. The structure is similar to that of the Italian specimen and to others from Pennsylvania, but this is the rudest example of the kind in the museum.

NEW ENGLAND HEDDLE FRAMES.

The writer is greatly indebted to Mrs. Alice Morse Earle, author of the charming work on Life in Colonial Days, for a photograph of a loom belonging to this stationary type for making silk braid, from Long Island, set up in operation. The furniture of the room and the costume of the weaver are all in harmony with the instrument itself, and reproduce, as nearly as possible, the time in which these heddle frames were in common use throughout New England and the Eastern States. There is room for thirty-three warp threads, though it is possible to weave with a smaller number. Mrs. Earle, after speaking of the large, home-made looms seen in all thrifty New England houses, makes the following observation on the heddle frames:

"Smaller looms, called tape looms, braid looms, belt looms, garter looms, or 'gallus frames,' were seen in many American homes, and useful they were in days when linen, cotton, woolen, or silk tapes, bobbins, and webbings or ribbons were not common and cheap, as today. Narrow bands, such as tapes, none-so-pretty's, ribbons, caddises, ferretings, inkles, were woven on these looms for use of garters, points, glove ties, hair laces, shoe strings, belts, hatbands, stay laces, breeches suspenders, etc."*

Specimen 175,641 in the U. S. National Museum is a heddle frame from Bristol, Connecticut, made from a thin board of maple wood. The upper portion consists of twenty-two healds 8¾ inches long, sawed out from the top as in Fig. 10. These, together with twenty-one spaces, provide for forty-three warp filaments, and this portion of the apparatus is 9 inches wide. The tops of the healds fit in a groove of a rectangular block of oak which furnishes a framework to the upper border. On opposite sides, at the bottom of the healds, are riveted semicylindrical strips of the same material, strengthening the apparatus at that point. The continuation downward of this upper or working part forms a base 17 inches long, cut out in a pattern resembling a vase or lamp stand. This stand is inserted in a groove at the end of a piece of oak and held fast by wooden pegs. Finally, the oak piece is firmly set in and mortised into a heavy block of wood which acts as a foot to the apparatus.

This specimen belongs to the class of stationary heddle frames as in the examples from Siena, Italy, and from Lancaster, Pennsylvania. The specimens from Maine and Connecticut, held between the knees of the operator, really belong to the same type.

Mrs. F. R. Post, of Hebron, Connecticut, has one of these heddle frames cut out of a single piece of wood, on which her grandmother when young used to weave garters, etc., for her mother and her sisters, and her mother had also used it.

The warp was laid off in proper lengths by being wound around chairs, run through the holes in the healds and between slats; the outer ends were tied together and fastened to some object and the inner ends were held in the hand of the weaver. The weaver held the heddle between her knees by means of the projecting lower part or handle, and taking the inner ends of the warp in one hand, she raised and lowered it alternately. The slats allowed the warp to spring the same as the harness in a loom. The filling was put in with her other hand by means of a simple shuttle, and beat up with one finger.

Mrs. Louise G. Strong, of Colchester, Connecticut, also sent to the U. S. National Museum models, in cardboard, of these primitive hand looms, and with them two specimens of work done thereon. The first specimen is tough white linen tape one-fourth of an inch wide, used in old country houses for making loops on towels and other fabrics to hang them up. The other example is in worsted; the warp is a series of black, green, red, olive, and blue worsted thread; the woof is a salmon-colored worsted thread, but it is invisible on the surface of the fabric, the warp having been driven hard home, so as to give it a twilled effect.

Mrs. Strong says that the loom on which these were woven was used in her family eighty years ago for making substantial fabrics, but more especially as a pastime for young women.

It is quite possible that examples might be found in northern New England States. The form in which the heddle made of a single piece of board is prolonged to be held between the weaver's knees or to be set in a block of wood on the floor is peculiar to New England, so far as the U. S. National Museum collection testifies.

PATENTED HEDDLE FRAMES.

As the climax of this type of the stationary heddle frame, attention is now called to the United States patent No. 334,320, granted in 1886 to Eugenia Wernicke, a subject of the King of Prussia, residing at 7 Besselsstrasse, Berlin.

In the Wernicke patent the heddle frame, in the drawing, shows twenty-seven healds made of wire or cord, with stirrups in the middle. The shuttle for holding the thread is a seine needle lenticular in cross section, tapering at its extremities, and provided at each end with an eye. Other attachments to this device form part of the patent, namely, for holding the warp in good shape, so as to secure uniformity of width in the textile; clamp for holding the apparatus to the table, etc., all unimportant in this place, the principle of operation being the same as in those previously described from Germany and other parts of Europe.

HEDDLE FRAMES FROM THE PUEBLO REGION.

This interesting region occupies the valley of the upper Rio Grande, the Territories of New Mexico and Arizona, and also portions of southern Utah, southern Colorado, southern California, and northern Mexico. It was first invaded by Spaniards when Cabeza de Vaca crossed it in 1536, and visited by Francisco Vasquez de Coronado in his expedition to search for the Seven Cities of Cibola in 1540. After this the region was occupied by Spanish settlers, sheep were introduced, and weaving in machines began. Some of the rude mechanical appliances of this class existed there doubtless before of Mexican type, since in the ancient ruins and cave dwellings textile fabrics of excellent quality are found. But no relic has, up to this time, been exhumed which connects the heddle frame here described with anything earlier than the Spanish occupation, nearly 400 years ago.

The most interesting part of this study, however, is a large collection of heddle frames from the pueblo region of the United States for weaving garters, belts, and other narrow ceremonial fabrics, sometimes in plain color, more commonly in stripe and diaper effects in different colored warps, quite similar to those of the Finlanders. A number of sections of reed or split mesquite sticks are laid parallel, as in the batten of the ordinary loom. These are fastened at their ends on two parallel sticks, which constitute the framework, whose length depends upon the number of warp threads to be inserted in the garter or belt.

An interesting feature in the structure of many of these pueblo heddles is the occurrence of the wooden cross piece at the upper part, on the opposite side from the cross piece at the bottom. When one of these hed-

* Washington Matthews, Navajo Weavers. Third Annual Report of Bureau of Ethnology (1884), pp. 371-378.

* Upon the Cassupic population of Farther Pomerania see Baltische Studien, by Dr. C. A. Hass, pp. 33-868, and Blätter für Volkskunde, IV, pp. 51-81.

* Alice Morse Earle, Home Life in Colonial Days. New York, 1898, p. 235.

dles is held perpendicularly in the hand, if the upper cross stick is on the side next to the eye, the lower one will be on the outside away from the eye.

The Algonquin Indians sit upon the ground at their work; so do the pueblo tribes. Hence the free-swinging heddle is more convenient for them. The same may be true of the east German types. Fig. 11 shows the attachment of the warp to the cylindrical stick in front of the weaver, which by courtesy may be called the primitive "cloth beam." It is held in place by a strap around the back, buttoned on the end of the roller, serving also as a roller for the finished work. The method of administering the heddle and the batten is clearly exhibited (Fig. 11).

This pueblo series is of such importance that the typical forms will be more minutely described, and a table given of all the specimens so as to bring out the characteristics which they have in common and those which serve to differentiate them.

It is regrettable that the author has not been able to extend his inquiries into France and Spain. Hypothetically, the heddle frame came from Europe or southwestern Asia. The Finns, the Germans, the Sauks, and the Pueblo tribes have the free-swinging heddle frame. The New England women, who sit in chairs at their work, the Pennsylvania Dutch, and the Italians used the stationary frame, making the "sheds" by raising and lowering the inner or cloth ends of the warp.

Those weavers that sat on the ground and employed the free-swinging heddle could use a sword or paddle batten, serving to make the "sheds," to separate certain warp filaments for figure working, and for beating home the weft. Only rich patterns occur where the free-swinging heddle frame is employed. Not enough is known of the spread of this last apparatus in Europe to show the definite manner of its introduction into Iowa and the Pueblo region. On weaving with little boards in Bagdad and Mesopotamia, see C. F. Lehmann.*

THE CURRENTS IN THE GULF OF ST. LAWRENCE.

GENERAL Characteristics of the Gulf of St. Lawrence.—With the exception of the currents in the various straits and near the heads of the bays, the currents met with in the open Gulf seldom exceed one knot. They are, therefore, the more easily influenced by strong winds, especially at the surface of the water. Currents which have a greater speed than this are found in Belle Isle and Cabot Straits, in Northumberland Strait, off the Gaspé coast, in the Gut of Canso, and locally in channels between islands and at the mouths of rivers.

The water of the Gulf may be roughly divided by a line running from Southwest Point of Anticosti to the middle of Cabot Strait. Along the southwestern side of this line the water has a lower density, as it is apparently made a little fresher by the outflow of the St. Lawrence River. To the northeast of this line, throughout the northeastern arm of the Gulf, the water has the same density as in the open Atlantic.

The general drift of this water of lower density is outward, toward the Atlantic. This gives rise to two constant currents, one at the mouth of the St. Lawrence along the Gaspé coast, which may be called the "Gaspé Current," and the other on the west side of Cabot Strait around Cape North, which may be called the "Cape Breton Current." A third constant current is found on the west side of Newfoundland, making northeastward from the Bay of Islands toward Rich Point.

It is to be noted that in calling these currents constant it is only meant that they usually or most frequently run in the one direction. During certain winds they may be much disturbed, or their direction may even be reversed.

Temperature.—It appears that in general the temperature of the surface water merely rises with the progress of the season; and it is also natural that the water should become warmer to a greater depth as the season advances. Even this has its limitations, however; as at a depth of 50 fathoms no greater rise in temperature has yet been found than from 32 degrees to 34 degrees, between the month of June and the end of September.

At all three angles of the gulf it was found that the coldest water forms a layer between the depths of 30 and 50 fathoms. In the vicinity of Belle Isle Strait the same low temperatures are also found at these depths; although there the temperature toward the surface is relatively lower, as a rule, than in other regions. It is probable that this cold layer extends very generally over the gulf area. Below this cold layer, in the deep channel of the gulf, the temperature from 100 to 200 fathoms is found to range very constantly from 38 degrees to 41 degrees. This result was obtained in Cabot Strait, and also between the Gaspé coast and Anticosti, 220 miles further in from the Atlantic, along the deep channel. This deep channel runs into the gulf from the Atlantic basin through Cabot Strait, and maintains a continuous depth of some 200 fathoms across the middle of the gulf to the mouth of the St. Lawrence River. It still has a depth of 100 fathoms half-way up the estuary on the Lower St. Lawrence.

Density.—It may be stated broadly that throughout the northeastern portion of the gulf the average surface density ranges from 1.0235 to nearly 1.0245; while in the southwestern portion the density is below 1.0235, ranging usually down to 1.0220, and falling in the Gaspé Current itself to 1.0210. The dividing line between these two portions of the gulf runs approximately from Southwest Point, Anticosti, to a point in the middle of Cabot Strait. The densities in the border region near this dividing line naturally vary to some extent. The density of the northeastern portion is practically the same as in the open Atlantic, as it was there found to range from 1.0237 to 1.0242, as shown by seven determinations made at the end of June off the south and southeast coasts of Nova Scotia.

This result is important in showing that the lower densities found in the southwestern portion of the Gulf of St. Lawrence are confined to that side; and this also accords with the conclusion that the general set or drift across the gulf is in the direction of a line from Gaspé to Cape Breton. On the other hand, the endeavor to obtain some differences locally, which would correspond with the various directions of the current, was without result; although a large number of temperatures as well as densities were taken for this purpose.

The deep water as found from samples taken at depths of 100 and 150 fathoms, both in the vicinity of Gaspé and in Cabot Strait, ranges in density from 1.0254 to 1.0261. The density of this deep water is very interesting in affording an explanation for the otherwise anomalous fact that the colder water at 50 fathoms is found to float upon it. It also corresponds with the density at similar depths, off the coast of Nova Scotia.

Current Across the Gulf Area.—The general connection of the Gaspé and Cape Breton currents became evident when it was ascertained that the water of lower density kept to the southwestern side of the gulf. The observations of the current in open, and the reports from steamships, also accord with a general movement of the water toward the southeast, as this is the more usual direction, and the currents which are found at times to run across this prevailing direction are to be attributed to the influence of the tides and the wind.

As to the route taken by the water in traversing the gulf from the Gaspé region to Cape Breton, it seems fair to conclude, from the evidence furnished by the density observations, that the greater proportion finds its way eastward between the Magdalen Islands and Prince Edward Island, while a certain amount may also pass north of the Magdalen Islands, on the line from Bird Rocks to St. Paul Island. It is probable, also, that some of the water may come from Northumberland Strait, as the water there is also low in its density.

For a discussion of the probable reasons why the water of lower density keeps to the southwestern side of the gulf, the reports of the Tidal Survey may be referred to.

The St. Lawrence River in Relation to the Outflow from the Gulf.—It can hardly be doubted that the low density of the water in the Gaspé Current is to be attributed to the outflow of the St. Lawrence River; and we are thus able to trace the influence of this water as far as Cape Breton, where it finally mingles with the water of the ocean. The volume discharged by the St. Lawrence has been measured at different seasons, and with the addition of the principal tributaries along its estuary, the total volume of fresh water discharge would probably amount in all to 340,000 cubic feet per second. This volume of fresh water will mingle with sea water for which we may assume a density of 1.0240, as this may be taken to represent either the mean density of Atlantic coast water to a moderate depth, or the density of the salter water in the gulf itself. Under these conditions, the fresh water of the St. Lawrence would be sufficient to furnish a stream of water reduced to the lower density of 1.0230 which would be twelve miles wide and 68 feet deep, and moving with a speed of one knot per hour. This would represent the average density of the Gaspé Current, and would probably be an approximation to its average speed [illegible] its volume; and such a comparison may therefore se[illegible] illustrate the way in which the conditions ma[illegible] accounted for, if the data themselves were more closely known.

It is to be noted, however, that as regards volume the St. Lawrence River is almost insignificant as compared with the outflow of the Gaspé Current. This current, whether it flows near the coast or in the middle of the passage between Gaspé and Anticosti, has usually a width of about twelve miles. The total depth immediately off this coast is over 100 fathoms, and the depth or thickness of the current itself was ascertained from measurements of the under-current taken as far down as 30 fathoms, at times when the surface speed varied, as usual, between one and two knots. It results from these measurements that we may consider the volume of this current to be represented by a body of water 12 miles in width, with a mean depth of 30 fathoms, and moving with an average speed of 0.68 knot per hour, throughout this depth.

Such a current has a volume forty-three times greater than that of the St. Lawrence River. The volume of the Cape Breton Current, also, is probably much the same. These outflows must therefore be replaced by a return movement at the entrance to the Lower St. Lawrence, somewhere in the Anticosti region; and also by a return flow from the ocean into the gulf area, as the discharge of the St. Lawrence furnishes less than 3 per cent of the amount required in either case.

The current which usually makes inward around Cape Ray on the east side of Cabot Strait may be sufficient to compensate for the outflowing water of the Cape Breton Current; although it is also possible that the outflow from the gulf may be partly made up for by the difference of flow in the inward direction through Belle Isle Strait, which in some years may be considerable in the early spring. This inflow at Cape Ray is in continuation of the general westward tendency of the water along the south coast of Newfoundland. The quiescence of the deep water in Cabot Strait is also to be noted in this connection.

It may be well to remark, however, that although the outflowing water of the Cape Breton Current is much warmer in the summer season than the incoming Atlantic water, it is not so at all seasons of the year. While it is probable that the total result is on the side of loss of temperature to the gulf area, it would require extended observations throughout the year to ascertain the amount of loss and the probable effect in consequence, upon climate in the surrounding regions.

The Current in Belle Isle Strait in Relation to the Gulf Area as a Whole.—On account of the tidal character of the current in Belle Isle Strait it is clear that no great volume of water can enter the Gulf of St. Lawrence from that quarter.

During the summer season the current flows in the strait with a speed which is nearly equal in each direction; and there is only a difference in favor of inward flow to the west, which on the whole does not probably amount to more than a moderate percentage. From the discussion of all the evidence secured, it is perhaps possible that in the early spring the preponderance of inward flow may be proportionally greater than at other seasons. But no reasons have been found for supposing that this water passes completely round the west coast of Newfoundland and finds its way out into the Atlantic through Cabot Strait, between Cape North and Cape Ray, in accordance with the theory which has been more or less accepted up to the present time. All the indications are against this theory, as they show that any general current across the extent of the gulf must lie in an entirely different direction. The reasons for this conclusion are discussed in the Tidal Survey Report, in which the tidal character of the flow in this strait is described and the relations of the current to the tide, the temperature of the water and the drift of icebergs are fully explained. A diagram showing the flow of the current in the two directions as observed is also given.

General Circulation in the Gulf.—In reviewing the movements of the water, with a view to tracing the general circulation in the gulf, it is the principle of the balance of flow which is the most evident. Wherever a current of a constant character occurs, there is a corresponding return current to make up for it. Thus, in Cabot Strait, the outflowing water in the Cape Breton Current is balanced by the inflow at Cape Ray; the northeastward current on the west coast of Newfoundland is balanced by the contrary direction of the movement on the opposite shore; and we have fairly good indications of a return flow to compensate for the Gaspé Current.

It is this balance of flow which points to the nature and direction of the circulation of water in the gulf. If we begin to trace it from Cabot Strait, where the balance between the gulf and the ocean takes place, the inflow at Cape Ray appears to diffuse itself more or less widely over the central part of the gulf, but it regains its strength further north on the west coast of Newfoundland, and makes a deep bend into the northeastern angle of the gulf, and returns westward along the north shore. On reaching Cape Whittle it still makes westward; and, whether as an actual set or by displacing water which comes more directly from Cape Ray, it appears to work around the eastern end of Anticosti, and so compensates for the outflow of the Gaspé Current, from the estuary of the St. Lawrence. This current, after rounding the Gaspé coast, makes southeastward as a general set or drift across the gulf to the western side of Cabot Strait; and its waters there leave the gulf in the outflow of the Cape Breton Current.

It also appears that the whole of the balance or compensation in the gulf currents takes place at the surface and in ordinary under-currents, which do not probably extend to a greater depth than 50 or 60 fathoms at the most. There is nothing, therefore, to show the necessity for any appreciable movement in the deep water from 60 to 80 fathoms downward, which lies in the deep channels of the gulf. Where direct observations have been obtained, this deep water appears to lie quiescent, without any movement that can be detected.—Abstract by Nature of a pamphlet issued by the Department of Marine and Fisheries.

THE BRITISH AND GERMAN ANTARCTIC SHIPS.

THE two great Antarctic expeditions have made a stride toward completeness by the launch at Dundee and Kiel of the exploring ships "Discovery" and "Gauss," both vessels built, at great expense, specially for service in the Antarctic ice. No complete official announcement of the organization and programme of either expedition has yet been made. However, the two ships are afloat, and appear to be the finest vessels for ice-navigation ever constructed, not even excepting the "Fram," which, of course, was planned for drifting with the ice-floes, not for sailing through them.

The following table compares the chief dimensions of the two vessels, so far as we have been able to ascertain them:

		Discovery.	Gauss.
Length over all	(feet)	—	168
Length at water line	(feet)	172	—
Length between perpendiculars	(feet)	—	151
Extreme breadth	(feet)	34	35
Probable displacement fully loaded (tons)	....	1,750	1,450
Horse power	....	450	300-500
Rig	....	Bark	Barkentine
Complement all told (souls)	....	46	28

It is stated the name "Gauss" was given to the German vessel by the Emperor to emphasize the scientific character of her mission by associating it with the memory of the great authority on terrestrial magnetism.

The German vessel, although a little smaller than the "Discovery," is intended to carry so much smaller a crew that she will probably prove to be no more crowded with her stores and equipment. Both vessels are strongly built of oak and sheathed in greenheart. The "Discovery," like the "Fram," has her frames in contact throughout her whole length, and the joints calked so that even if all her triple skin of planking were stripped from her the vessel would still be watertight and seaworthy. She is of whaler pattern to the extent that her sides are not pierced by any openings, the only daylight for the cabins coming from decklights; but the cabins, though dark and uninviting at the launch, are exceptionally roomy and well-planned, and when lighted by the electric light will be extremely comfortable. The "Gauss" is also to be furnished with the vital necessity of electric light, a boon that none but polar voyagers can fully appreciate, and she is, in addition, to have the luxury of steam-pipes for heating purposes throughout the whole inhabited part of the ship; the "Discovery" will probably be heated by stoves.

Both vessels are provided with wells and gear for hoisting out both rudder and propeller, and a spare rudder will be carried which can be shipped securely and speedily if the original steering gear should be seriously damaged. The bows of both ships are heavily plated with steel to enable them to cut through or break comparatively thin ice; but the form of the stem is different. Both have a great sheer, so that the vessel would tend to ride up on any floating ice she encountered and break it with her weight, but the stem of the British ship is a straight line forming an obtuse angle with the keel, while that of the German

* Verhandl. d. Berliners Gesellsch. f. Anthrop., etc., May 19, 1900, p. 299.

vessel is a convex curve. The sterns also differ, that of the British vessel having a much longer overhanging counter than the "Gauss," so that her length over all is probably from 15 to 20 feet greater.

The details of laboratory accommodation can be more profitably described when the space is finally apportioned and the equipment in place; but the magnetic observatory on the "Discovery" has been very carefully planned so that it shall be more than 30 feet from any iron or steel—even the bolts and nails in its vicinity are all of brass.

The living rooms in both vessels are amidships, the stokehold and engine-room being placed right aft, while the whole lower hold is utilized as a great coal-bunker along the length of the ship. The "Discovery" is rigged as a bark; the rig of the "Gauss" is officially described as that of a "three-masted schooner," but her published sail-plan shows the foremast completely square-rigged, the main and mizzen having only fore-and-aft sails, so that she is better called a barkentine. We believe that this rig, rendered necessary probably on account of the small crew carried, is not a usual one for polar ships. Machinery and masts are now being rapidly put in place, and the "Discovery" may be expected in the Thames to take her stores on board about the end of May or early in June.—Nature.

THE HOUDAILLE CALCIMETERS.

THE tolerance by American graft-stocks, such as *Vitis riparia*, of carbonate of lime depends in the first place upon the gross percentage of this material in the soil of the vineyard, but it seems to be still more intimately connected with the power of assimilation of the lime. On the other hand, the wine-grower is not ignorant of the fact that the normal fermentation of the vintage depends on a proper degree of acidity and that the perfect preservation of the wine made depends also upon its richness in acid elements. Although the cultivator plants but once, he gathers his grapes once a year. So the use of calcimeters, such as those of MM. Bernard and Trubert, would be at present less widely dissiminated had not their inventors pointed out the adaptability of these apparatus to be used as acidimeters for wines and worts.

As to Houdaille's registering calcimeter, although it is capable of operating as an acidimeter, it is clearly distinguished from the instruments in common use. Designed for scientific researches, it permits the culturist to interpret the damage that the lime studied is capable of doing. Its high price and the delicacy of its mechanism, however, are obstacles to its purchase by small culturists and unscientific persons. As may be seen from an inspection of Fig. 1, the instrument consists of four parts, viz.: (1) The reaction vessel, *F*, of 125 cubic centimeters capacity, connected by a rubber tube with (2) the accumulation reservoir, *N*, (3) of a siphoid pressure gage and inscribing style, *S*, which bears upon (4) the registering cylinder, *C*, movable around its vertical axis and controlled by the clockwork movement, *M*. Upon setting the latter in operation the cylinder revolves and the immovable point of the style describes a horizontal circle upon the surface of the cylinder, which is covered with cross-section paper.

Into the vessel, *F*, are introduced 500 milligrammes of the earth to be analyzed, together with a measureful of dilute hydrochloric acid. The vessel is then closed, and the clockwork movement, *A*, which plays the part of a mechanical agitator of *F*, is set in operation. The reaction which takes place in *F* disengages a quantity of gas, which first becomes cooled in the reservoir, *N*, and then accumulates in the short branch of the pressure gage and forces the mercury forward in doing so. The level of the liquid then rises in the large open branch and raises a float connected with the inscribing style, *S*. This latter, finally, under the impulse received, describes an ascending curve upon the paper that covers the cylinder in motion. At the end of the reaction, the curve again, as at the beginning, becomes a horizontal circle, but distinct from the first.

The paper is afterward unrolled upon a plane. This converts the circles into straight lines, and the curve of reaction is studied in comparison with that obtained when 500 milligrammes of pure carbonate of lime were used. The ratio between the maximum ordinates or deviations denotes the gross percentage of carbonate of lime, save a few subsequent corrections into the details of which we shall not enter.

Upon the whole, this apparatus would present no advantage over the ordinary calcimeter did it not permit of measuring with precision the noxious power of the carbonate of lime—a very interesting factor for the agriculturist. To do this, the earth is no longer attacked by hydrochloric acid, which is too powerful a solvent, but with tartaric acid, which, through its affinity with the carbonate, is more comparable to the vital forces of absorption that draw the carbonate of lime from the depths of the earth and introduce it into the cells of the plant.

With tartaric acid, in fact, there is deposited upon the grains of the calcic carbonate a stratum of tartrate of calcium which is but slightly soluble and is capable, by its accumulation, of interfering with the action on the carbonate of lime unless it is in a very divided state. Therefore, if the tartaric acid gives a curve which is not so high as that of hydrochloric acid, it is because the attack is not integral. It is a question then of a coarse calcic carbonate not very injurious to the vine. Moreover, the speed of attack by the tartaric acid, which is intimately connected with the chlorosing power of the soil, becomes easily measurable. In practice, the operator takes as a basis the number of seconds necessary to dissolve the first third of the carbonate of lime contained in one gramme of earth.

If we introduce separately into the vessel, *F*, 33 cubic centimeters of wine and 5 cubic centimeters of a 10 per cent solution of bicarbonate of soda, and make a mixture thereof, the calcimeter will play the role of an acidimeter. But the registering apparatus will hardly ever be operated except in laboratories, and in these the Pasteur method will always be preferred.

Let us now pass to the aneroid acidimeter-calcimeter (Fig. 2), which is better adapted for the use of small culturists. Like all instruments of the kind, it consists of a reaction vessel the plug of which is provided with a rubber tube; but the gases expelled by the reaction, instead of expanding freely, as in the Bernard model, or of depressing a column of mercury, as in the registering apparatus, accumulate in a double flexible metallic box, *N*, which they very slightly distort. This inperceptible motion is shown in the end by the movement of a pointer, *S*, along a scale graduated either into hundredths for lime (calcimetry), or into grammes of sulphuric acid per liter (acidimetry of wines and worts).

The internal expansion developed remains always feeble, even in extreme cases, and does not approach the limit of elasticity of the box. Even though slight modifications occur either in the flexion of the metal or in the temperature of the experiment, since the graduated cardboard before which the needle revolves is movable in the vertical slide, *O*, which itself is capable of lateral movement upon its base, it is always easy to regulate the zero at the beginning of each experiment. It must not be forgotten that the scale is not graduated according to theoretical data, but after preliminary experiments. If the apparatus gets out of order after operating well at first, it is always possible to regulate it by means of a measureful of pure calcic carbonate. Such a regulation is necessary even if the reaction vessel, *F*, be changed. It is effected by modifying the lengths of the arms of the levers.

For calcimetric experiments 200 milligrammes of earth are weighed on a balance of precision, and introduced into the reaction vessel. The sides of the vessel are washed with 5 cubic centimeters of pure water, and the measure is filled with 5 cubic centimeters of hydrochloric acid at 11° B.

As for the acidimetric experiments, they are made with 25 cubic centimeters of wine or wort boiled and then cooled, and with a glass containing about two grammes of well pulverized chalk. The graduation does not exceed the degree of 8 grammes per liter of sulphuric acid, say a little more than 12 grammes of tartaric acid. Although it is exceptional that the acid of a wine exceeds such a limit, it often happens with a wort; so it will be well to reduce the wort previously with an equal quantity of water. Moreover, from the moment that the acidity of the liquid becomes fully sufficient, its exact degree becomes less interesting to know.

Upon the whole, the manipulation of the Houdaille calcimeter is simple and rapid, but we should like to see a little more simplicity introduced into the method of regulation. It is perfectly understood that the preservation of the mechanism requires great cleanliness on the part of the operator; but any one who cannot protect his aneroid calcimeter against dust or acid vapor would do well to give up the practice of agricultural chemistry.—For the above particulars and the engravings, we are indebted to La Nature.

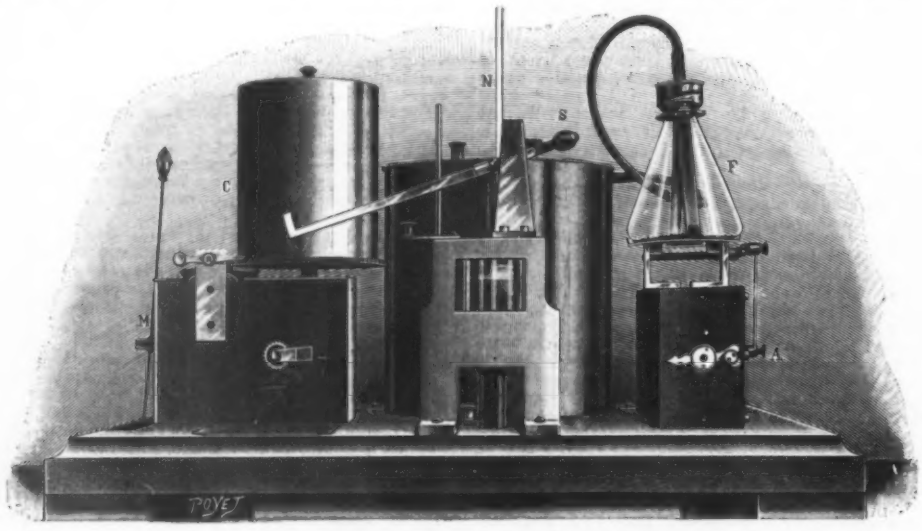


FIG. 1.—REGISTERING CALCIMETER.

CO-OPERATION IN OBSERVING VARIABLE STARS.

THE number of known variable stars of long period is now so great, and is increasing so rapidly, that the observation of many of them has been greatly neglected. Observations by Argelander's method are so easily made that they are especially adapted to observers who, for various reasons, cannot use precise photometric methods. In the case of variables of small range, including those of short period and many of the Algol variables, the subjective errors greatly diminish the value of observations by Argelander's method. In these cases, also, the periods and light curves appear to be so regular that continuous observations are not needed. It appears to be better to observe such objects photometrically throughout their variation, if possible, and thus determine the light curves. Small variations in the period can then be determined by occasional observations at times when the light is varying most rapidly. Many of the variables of long period appear to change irregularly, and continuous observations are required until the nature of the changes is known. Moreover, the range is, in many cases, so great that the errors of observation are not sufficient to affect seriously the form of the curve. The method of observations for these stars, which has been in use here for the last twelve years, is as follows:

A sequence of comparison stars is first selected as near the variable as possible, and each about half a magnitude brighter than the next in order, the brightest being somewhat brighter than the variable at maximum, and the faintest, fainter than the variable at minimum. Care is taken not to include double stars or those near brighter stars. The stars brighter than the tenth magnitude are then measured with the meridian photometer. This has been done for nearly all of the comparison stars selected here. Magnitudes determined with the meridian photometer, for all stars of the seventh magnitude and brighter, can now be furnished upon a uniform system. For the fainter stars, measures have been made of large numbers of stars as faint as the thirteenth magnitude, and photometers are now in use with which the faintest stars visible in the largest telescopes can be measured. As the apparent magnitude may sometimes differ from the measured magnitude, it has been found best to estimate independently on several nights the interval between each of the adjacent stars in the sequences and adopt magnitudes found by combining these estimates with the photometric magnitudes. Having thus provided standards of comparison on the same scale for stars in all parts of the sky, a variable may be compared on any night with the stars nearest it in brightness in its sequence, taking care to select one that is brighter and another fainter. From estimates of these intervals in grades, the light of the variable is readily reduced to the standard scale. When a variable is faint, it is impossible to observe it for several days every month, near the time of full moon.

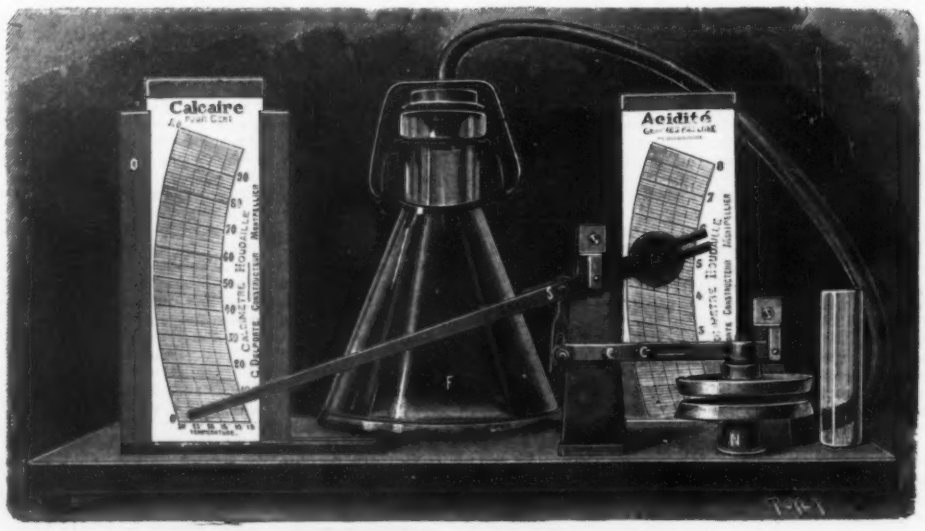


FIG. 2.—CALCIMETER WITH ANEROID BOX.

At least the observation should be obtained in the interval between successive times of full moon. This can only be done for polar stars, owing to the proximity of the sun at certain seasons. Since the periods of a large portion of the variables of long period exceed half a year, it is evident that monthly observations will, in general, give a good idea of the form of the light curve. Of course, additional observations should also be obtained, but failure to secure any observation during a long interval should be avoided if possible. Since 1889, an attempt has been made to observe seventeen circumpolar variables, north of declination + 50°, at least once a month. These stars are always above the horizon at Cambridge, so that they can be observed at all seasons. The results for the years 1889-1899 will be found in Volume XXXVII., Part I., of the Annals, which is now printed and in process of distribution. Similar observations have been made of about sixty other variables, but less regularly. At Arequipa, similar observations have been made of a large number of southern variables. It is much to be desired that all variables of long period should be observed in the same way, or at least so that all can be reduced to a uniform scale of magnitudes. Co-operation is necessary to attain success in this work. Variables near the ecliptic can be observed when near the sun much better at tropical stations than at those near the pole. The reverse is true for polar variables. Northern variables can be observed for a longer portion of the year at northern observatories and southern variables at southern observatories. When a variable can be observed only in the morning it is much more likely to escape observation than at other seasons. A computation has been made of the date on which the variables mentioned above are 20° above the horizon at Cambridge at midnight, and also in the morning and evening when the sun is still 10° below the horizon. Thus, these three dates for the star, T Andromedæ, are July 1, May 1, and March 12. Accordingly, from May 1 to July 1 this star can be observed only in the morning, from July 1 to March 12 it can be observed in the evening, while from March 12 to May 1 observations are difficult owing to twilight. When a variable is bright it is best observed with a small telescope, that is, one having an aperture of not more than 6 or 8 inches. Observations of great value could be obtained by an observer with a large telescope if he was notified when the star was too faint to be observed with smaller instruments. The excellent charts of Father Hogan are almost indispensable for observing the stars when fainter than the ninth magnitude. When the variables are bright, the need has been felt here for charts on a smaller scale and covering a larger region. After various experiments, photographic enlargements have been made of portions of the admirable charts of the Bonn Durchmusterung. A region 3° square, surrounding each variable, has been enlarged three times, thus giving a map on the standard scale of one minute of arc to one millimeter. The stars on these maps, while appearing coarse by daylight, are thus easily seen and identified at night without using a light bright enough to dazzle the eye. The designations of the stars in the sequence are marked upon these enlargements, and copies will be furnished at cost. Charts will be furnished free of cost to experienced observers who are ready to co-operate in the above plan of work. Observations of nearly equal value can be obtained by those unaccustomed to estimating intervals in grades. It is only necessary to enter on the charts the standard magnitudes of the comparison stars, and from these to estimate directly the magnitude of the variable. Charts are now being prepared, and with the corresponding magnitudes can soon be furnished for the following stars:

T Andromedæ, T Cassiopeiæ, R Andromedæ, S Ceti, S Cassiopeiæ, R Piscium, R Arietis, *o* Ceti, S Persei, R Ceti, U Ceti, R Tauri, R Aurigæ, U Orionis, R Lyncis, R Geminorum, S Canis, Minoris, R Cancri, V Cancri, S Hydræ, T Hydræ, R Leonis Minoris, R Leonis, R Ursæ Majoris, X Virginis, R Comæ Berenices, T Virginis, R Corvi, Y Virginis, T Ursæ Majoris, R Virginis, S Ursæ Majoris, U Virginis, V Virginis, R Hydræ, S Virginis, R Canum Venaticorum, S Boötis, R Camelopardali, R Boötis, S Libræ, S Serpentis, S Coronæ Borealis, R Herculis, R Scorpii, S Scorpii, U Herculis, V Herculis, R Ursæ Minoris, R Draconis, S Herculis, R Ophiuchi, T Herculis, R Scuti, R Sagittarii, R Cygni, χ Cygni, S Cygni, R S Cygni, R Delphini, U Cygni, V Cygni, T Aquarii, R Vulpeculæ, T Cephei, S Cephei, S S Cygni, S Aquarii, R Pegasi, S Pegasi, R Aquarii, and R Cassiopeiæ.

If the above plan proves successful, it is hoped that it may be extended to the other variable stars of long period.

EDWARD C. PICKERING.

January 16, 1901.

AMADOU, TOUCHWOOD, TINDER OR SPUNK; ITS HISTORY AND USES.

By FREDERICK LE ROY SARGENT.

ONE of the most memorable sensations which a person receives in the dentist's chair is when a little wad of an innocent-looking, soft, brown substance is thrust into a tooth to make sure that the cavity is perfectly dry. The volume of ache which commonly ensues seems so entirely disproportionate to the size of the wad that patients of an inquiring mind are apt to ask what the stuff is. When told that *spunk* is its name, they are wont to accept this as a peculiarly fitting appellation for a substance whose action is so spunky while it lasts, and calls for such spunk to bear it without wincing.

What is this spunk, and whence its name? Is there really any connection between the name of the substance and the mental quality which it also denotes? Yes, there is such a connection, and it is thought that the following attempt to trace it may prove of general interest.

First, it should be said that spunk is obtained from one of the hard, hoof-shaped outgrowths, looking like inverted brackets, found not uncommonly upon the trunks of forest trees. Such growths on the trunk of a beech tree are represented in Fig. 1. These are tough, long-lived fungi, akin to mushrooms, which gain their living as parasites by sponging upon the food made by trees for their own use.

The species yielding the best spunk is known to botanists as *Polyporus* (or *Fomes*) *fomentarius*. It grows commonly in this country and in Europe. The market is supplied mainly from Hungary, Bohemia and the Pyrenees.

If we cut down through the center of one of these outgrowths, we find it to be composed of the various layers shown in Fig. 2, *A*. As will be noticed, there is an outer layer or rind (indicated by the thick black line), which serves to shed the rain and otherwise to

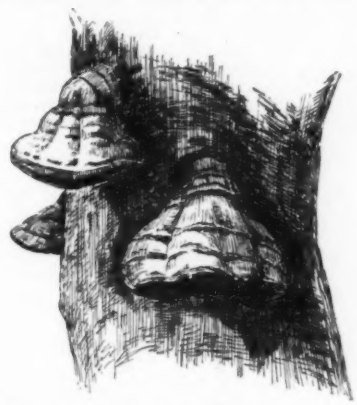


FIG. 1.—FUNGUS GROWTH ON A BEECH TREE.

protect the parts within. It is very hard and tough. Below this comes a much thicker layer of lighter color and much softer and more spongy texture (indicated by a network of fine, mostly wavy, lines). It is this layer of material which forms the spunk. Minute examination shows it to be composed of innumerable fibers of great delicacy, tangled and matted together into a felt-like mass. Portions of a few of these fibers with a bit of cotton for comparison are shown, much magnified, in Fig. 3.

Fibers like these form the bond of connection between the outer growth, which appears upon the tree-

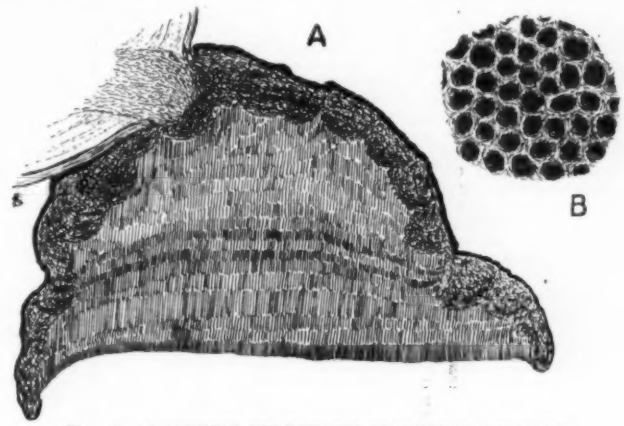


FIG. 2.—SECTION THROUGH VARIOUS LAYERS.

trunk, and the inner portions of the tree from which the parasite obtains all its nutriment. That is to say, similar fibers which have woven themselves into the tissues beneath the bark of the tree, to share its food, grow out through the bark and serve as channels for carrying the nutritious materials used in the formation of the fungus-growth outside. This outer growth is in reality the fruit of the fungus. The main bulk of it, as the drawing, *A*, Fig. 2, will show, is formed by what we may call the "core." This consists of rather firm material so arranged as to inclose innumerable vertical canals of small diameter open at the bottom. When we examine the lower surface of the fruit

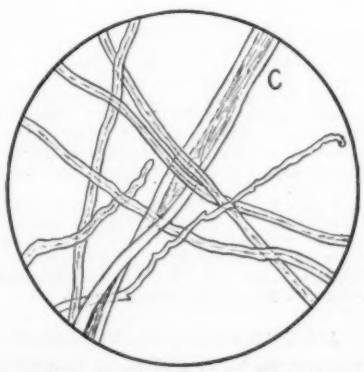


FIG. 3.—COMPARISON OF FUNGUS FIBERS WITH COTTON FIBER.

with a magnifier the openings to these canals appear like tiny pores, as shown in Fig. 2, *B*. The name *Polyporus* (many pores) was given to such fungi in reference to this peculiarity.

On the walls of these tubular cavities grow minute bodies called spores, which in a way answer the purpose of seeds. As soon as ripe, a spore becomes detached from the wall of its tube, and falls down and out through the opening below. A breeze may now carry it away and land it finally on the bark of another tree. If the conditions there are favorable for growth, it will sprout by sending out a delicate thread. This thread, now extracting nutriment from the surroundings, will elongate and branch, and in course of time may eat its way into the tree. Once among the more nutritious tissues within, the system of fungus-threads will grow rapidly and finally push out through the bark to form a fruit for the production of spores. The whole fungus from spore to spore may thus be viewed as a system of exceedingly delicate threads, variously tangled and comparted into layers.

The layer which forms spunk is separated for use by cutting away the other portions of the fruit. August and September is the time generally chosen for collecting the crude spunk. To prepare this for market, it is soaked in a weak solution of lye, then washed and dried, and finally pounded with a wooden mallet until it is as pliable as a piece of chamois skin.

The close resemblance of a sheet of spunk to soft leather has led to its use as a material for caps, tobacco pouches, and various ornaments, especially in the mountainous parts of Germany, where the fungus abounds.

Its softness renders it also of service to artists in charcoal or crayon drawing. They use it in much the same way as a chamois "stump" for removing an excess of the black material or otherwise modifying its distribution on the paper. For artists' use it is sold under the name *amadou*. Its superiority for this purpose doubtless depends upon the readiness with which the fibers of the spongy mass entangle the fine particles deposited on the paper by the charcoal or crayon.

To the extreme fineness of the fibers composing the felt-like layer of the fruit is also largely due its value in dental practice and for other uses to be mentioned. As will be seen from Fig. 3, *A*, spunk fiber is only about a fifth as thick as a fiber of cotton. Hence the extent of surface available for capillary attraction in a given space must be much more in spunk than in cotton, and the absorptive power correspondingly greater. Spunk will thus remove the last vestige of moisture from a cavity which a dentist wishes to fill. Why it should cause so much pain in the process is not altogether clear; but it is perhaps not unreasonable to suppose that the sensation may, in large part, depend upon the vigor and thoroughness with which the spunk fibers absorb moisture from the nerve-fibrillæ in the region of the cavity.

Spunk is also used by dentists to staunch the flow of blood in certain operations. It likewise serves as a convenient styptic in surgery, especially for checking the hæmorrhage from such small wounds as leech bites, and has been found most efficient in cases of nose bleed. The promptness of its action in this capacity is also to be attributed in great part to the fineness of the fibers, since this implies a large extent of surface-contact with the clotting blood.

In former times spunk was much used by surgeons as a moxa or slow-burning cautery. For this purpose the material was first soaked in a solution of saltpeter or of potassium chlorate, then dried and finally rolled into a cylinder. Moxas are now practically obsolete. The same may be said of the "port-fire," a sort of slow-match made of saltpetered spunk and formerly used in discharging artillery.

Moxas and port-fires were but special applications of the inflammable properties of spunk which made it widely used as tinder before the days of matches. As is well known, the old-fashioned way of getting fire was by striking sparks from a flint and steel into a mass of light, combustible material called tinder or touchwood. Pieces of charred linen were most commonly used for this purpose, but wide use was also made of spunk, as being especially suitable.

This is the principal use to which spunk was put in ancient times, and the one from which most of its names have been derived. The word tinder (equivalent to the German *Zünder*), it should be noted, means that which *tinds* or kindles. *Amadou*, the French name of spunk, and *amadouviers*, applied to the fungi which produce it, are derived from *amadouer* (to coax), presumably from its use in "coaxing" a fire to burn. The generic (or sub-generic) name *Fomes* is simply the Latin for tinder, and like the specific name *fomentarius* comes from *fovere* (to warm). The common English names, "touchwood," "slow-match," and "black-match," are applied also to other forms of tinder. A name applied especially to spunk and particularly expressive of its properties is the German *Feuerschwamm* (fire-sponge), which finds an approximate equivalent in the English name "pyrotechnical sponge."

Wundschwamm (wound sponge) and *chirurgisches Zünder* (surgical tinder)—names of spunk also employed by German writers—are plainly expressive of its surgical uses.

It is to the characteristic sponginess of this substance that we owe the common English names "spunk" and "punk." The latter name, perhaps the more familiar of the two, is doubtless a corruption of the former. An earlier English form of the word was *sponk*. This was derived from the Irish Gaelic *sponc*, meaning

sponge, spongy wood, touchwood or tinder, which in turn is connected with the Latin *spongia* (a sponge), from the Greek σπογγια or σπογγος (pronounced spongia spongos), signifying a sponge or any spongy substance. In Attic Greek the equivalent word was σφογγος (pronounced sphongos). From this, perhaps through *sfungus*, came the Latin *fungus*, which, as we know, is applied not only to such spongy plants as mushrooms, molds and the like, but also to other spongy growths. Students of the transformations of words tell us, furthermore, that from the same ancestral word-stock came the German *Schwamm*, which means not only a fungus, but also a sponge and a swamp, and is at the same time cognate with these three words.

In conclusion we may now briefly trace the different meanings which the word spunk has assumed since it became part of the English language. At first applied to the spongy part of a fungus used as tinder, it naturally came to be associated with the little flame or glowing spark produced by its means. Such a small fire, even though otherwise produced, came then to be called a spunk. "Spunks" was also the name given to the sulphur-tipped splinters of wood—the forerunners of our present matches—which were intended to be ignited from a glowing tinder. Finally that sort of spirit in a man which readily kindles with enthusiasm and maintains a lasting glow of purpose, ever heightened by the winds of adversity, came naturally to be known by the expressive though homely name of spunk.

THE CORPUSCULAR HYPOTHESIS.

THE lecture on cathode ray phenomena, delivered at the Royal Institution a short time ago by Prof. J. J. Thomson, served to bring before a more or less popular audience, says Engineering, to which we are indebted for the following particulars, the results of a series of remarkable researches which promise to inaugurate a new era in physics. The work carried out under Prof. Thomson's direction at the Cavendish laboratory has gone far to undermine the belief in the immutability of the atom, which resulted from the chemical and physical researches of the first three-quarters of the last century. In fact, though by chemical means it still seems impossible to break up an atom, it would appear that these units prove less resisting to electrical forces, and that the cathode rays, together with the peculiar emanations from uranium, polonium, and radium, consist of particles of matter having but 1-1000 the mass of the atom of hydrogen. It is, therefore, by no means improbable that the ordinary atoms of all elements are really little constellations of these smaller particles, which have been named corpuscles. What these corpuscles themselves are, is still a moot point. Some physicists believe they are not matter in any ordinary acceptation of the term, but are, so to speak, merely disembodied charges of electricity. So far as experience has hitherto gone, electric charges are known only as united to matter, but Dr. Johnstone Stoney and Dr. Larmor have both speculated on the properties of such charges if isolated, which by the former have been named electrons. Such a charge would possess inertia, even though attached to no matter; and, in fact, the increase in the inertia of a body due to electrification has been calculated by both Prof. Thomson and by Mr. Oliver Heaviside. The conception has, accordingly, being advanced that all inertia is electrical, and that matter, as we know it, is built up of interlocked positive and negative electrons. If in any mass of matter it were possible to separate these electrons, the matter would disappear, and there would remain merely two enormous charges of electricity. This theory as to electrons is, however, at present very insufficiently supported by evidence; and, so far as Prof. Thomson's experiments have yet gone, they negative the idea that mass is purely electrical, though the matter cannot at present be considered as definitely settled.

Leaving aside this aspect of the problem for the moment, it will be of interest to consider the ingenious manner in which the nature of the cathode rays has been established. The peculiar discharge from the negative electrode of a vacuum tube was investigated many years ago by Hittorf and by Sir William Crookes, who arrived at the conclusion that they were streams of charged particles, and discovered many of their more important properties. Later on, Leonard showed that the radiation could pass through many solid media, and established the fact that the same mass was needed to stop the flying particles, whatever its nature. Thus, a thin layer of a dense metal might be replaced by a proportionately greater thickness of a lighter one, or by a still greater thickness of a liquid or gas; the thickness needed being always inversely proportional to the density.

For many years it had been known that in electrolysis the current was conveyed between the electrodes by a stream of ions, which in many cases were atoms. Faraday had showed that all univalent atoms conveyed equal charges of electricity, while a divalent atom might convey two such charges, trivalent three, and tetravalent ones four such charges. This unit charge is about 10^{-20} coulombs, and being the smallest quantity of electricity of which we have any cognizance, has been called an atom of electricity, and corresponds to Dr. Johnstone Stoney's electron. The amount of electricity carried in electrolysis by an ion being known, it became of interest to make a similar investigation in the case of the cathode rays, and this is what Prof. Thomson has succeeded in doing. The amount of matter transported in this phenomenon is so small that it was impracticable to follow a direct method of measuring the total electricity transported and the quantity of matter conveying it. The difficulty was, however, turned in an ingenious way. The particles being highly charged are deflected if they are made to pass through an electrostatic field. At the outset there was a difficulty in demonstrating this, since the radiation has the property of rendering conductive any gas through which it passes. By operating in sufficiently rare media, however, this difficulty was surmounted. Secondly, a moving charge being equivalent to an electric current, the particles are also deflected when they are passed through a magnetic field. The experiment was arranged so that the two deflecting forces exactly balanced each other, leaving the path of ray undisturbed. In these conditions it can be shown that the velocity of the particles is

$$v = \frac{F}{H}$$

where F is the strength of the electrostatic and H the strength of the magnetic field. The velocity thus determined proved remarkably high, being in cases as much as 1-20 that of light.

Having determined this velocity, it was possible to determine the ratio of the mass of the particle to the charge it carried by observing the deflection of the rays when passing through a magnetic field, since Prof. Stokes had shown that in these circumstances the curvature of the path would be given by the equation

$$\frac{m}{e}\frac{v}{H} = \text{radius of curvature},$$

when m is the mass of the particle and e the charge carried. On making the experiment, it was found that if the flying particles were atoms, they carried 1,000 times as large a charge as in ordinary electrolysis. The question then arose, Were the particles atoms? Or, was not the charge the same as in electrolysis, while the particle was only 1-1000 times the mass of the atom? The question was not an easy one to answer, but by a stroke of genius, Prof. Thomson succeeded in counting the number of particles needed to carry a given charge, and discovered that the individual charge was the same as in electrolysis, and hence that the particles carrying them were only 1-1000 the size of the hydrogen atom.

The key to the solution of the question was found in an observation made many years ago by Mr. Aitken to the effect that no condensation took place in supersaturated air unless dust were present. In fact, theory shows that it is impossible for a rain drop to exist below a certain diameter. Hence, unless there is some nucleus on which it can condense, it cannot commence to come into existence. Mr. Wilson next proved at the Cavendish laboratory that dust could be replaced by the cathode particles, and in this fact Prof. Thomson perceived his way to estimating the number of these conveying a known charge. The rays were passed through saturated air, which was then suddenly cooled by expansion, thus rendering it supersaturated. The amount of supersaturation could be calculated, and hence the weight of moisture which could be condensed. The cloud formed consisted of minute droplets, and from the rate of fall of these, the diameter of each drop and its consequent mass could be determined. Dividing the total weight of the cloud by that of the individual droplet, the number of drops was obtained, and hence ultimately the number of corpuscles which acted as nuclei of condensation. As already stated, the final result was, that though the charge conveyed was the same as in electrolysis, the particle conveying the charge was only 1-1000 the weight of a hydrogen atom.

It appears, moreover, that these corpuscles are emitted not only from electrified bodies, but also from certain metals when exposed to violet light, and from all metals when sufficiently heated. Other metals, again, such as radium, emit them spontaneously, and Prof. Curie has now obtained specimens of this metal, giving a discharge capable of penetrating 4 millimeters of glass. The velocity of the corpuscles is, however, much less in these forms of radiation than it is in the case of the cathode rays. The corpuscles are always negatively electrified. So far, positively electrified particles appear to be never sensibly smaller than the atom.

The final outcome of these researches lies in the womb of the future, but as the atomic hypothesis has ultimately led to the many amenities of life dependent on industrial chemistry, we have no doubt that this corpuscular hypothesis will in its turn contribute to the well-being of humanity. In fact, these cathode rays, on impinging on a dense metal, give rise to the X-rays which have already proved of such service in surgery. Mr. Campbell Swinton has further shown that by turning the discharge on to a suitable target, a capital light is produced at a very small expenditure of energy, and has suggested the possibility that this fact may ultimately prove of industrial importance. These charged corpuscles appear also to be responsible for the Zeeman effect. When the spectral line of a body heated in a very strong magnetic field is examined by sufficiently powerful apparatus it appears broadened, and ultimately doubled, tripled, or quadrupled. Faraday suspected that something of this character should obtain and sought for it, but the apparatus available was not then sufficiently powerful. It is possible to calculate from the measured widening of the line and its known normal periodicity the ratio of the electric charge to the matter carrying it, and this is again found to be a thousand times as great as in electrolysis.

The puzzle of the universe will, no doubt, only be moved back one step further by Prof. Thomson's discoveries, and we shall doubtless be as far as ever from the dream of the materialists of the middle portion of the past century, who looked to an explanation of the Cosmos on purely mechanical lines.

LEFT AND RIGHT-HANDEDNESS.

IN a paper on "Left and Right-Handedness," Dr Lueddeckens gives some interesting information regarding this subject. It has been a well-known fact that the stronger activity of the nerves of the right half of the body (for not only the hand is concerned) must be ascribed to a preponderance of the left side of the brain, whose finer development, especially as the seat of the center of speech, is a matter of common knowledge. In the said paper, according to the German periodical "Woche," the question regarding the cause of the unequal working of the two hemispheres of the brain has been solved. A sketch dwelling on the history of evolution leads from the original symmetry of the organism to a subsequent asymmetrical arrangement of the heart and the large blood vessels, from which may be inferred quite naturally that the two halves of the head are not placed on an equal footing as regards the quantity of blood supplied and consequently of the blood pressure, and that on the contrary there must be under normal conditions a stronger pressure in the arteries of the left side of the head. This theory is supported by the well-known experiences of anatomists and pathologists and a series of interesting observations. Of especial interest is the effect of the greater blood pressure upon the left eye. Dr. Lueddeckens found in the latter, as compared with the right one, in a surprisingly large number of cases, a narrower pupil, in consequence of a more filled-up condition of the vessels of the iris, and upon closer examination a shorter construction of the eyeball. This furnishes the hitherto unknown reason for the fact that in a large number of persons the left eye is the better one. Thus, the finer development of the left half of the brain is explained very simply by the fact that it is better supplied with blood, and the question why it is the seat of the speech center and why most people are right-handed, is solved in the most natural manner. It is most remarkable how truthful a reflection of the above-described conditions is afforded by the examination of left-handed persons. In a large number of cases a more florid color was perceptible on the right side of the face; the right eye was built shorter, its pupil narrower; in short, everything pointed to a better blood supply on the right side of the brain, which in consequence imparts to the left side of the body the preponderance over the right one, a condition styled left-handedness. In relation thereto stands the habit of most left-handed persons, in opposition to other physiological laws, to sleep on the left side, in the unconscious endeavor to relieve the right half of their brain, which contains a larger amount of blood during the day. For the same reason the position on the right side is the normal one for right-handed persons.

UNEXPLORED CANADA.

THE director of the geological survey of Canada, in his last report, makes the amazing statement that practically nothing is known of one-third of the Dominion. He says:

"There are more than 1,250,000 square miles of unexplored lands in Canada. The entire area of the Dominion is computed at 3,450,257 square miles, consequently one-third of this country has yet been untraveled by the explorer. Exclusive of the inhospitable detached Arctic portions, 954,000 square miles is for all practical purposes entirely unknown."

A careful estimate is made of the unexplored regions. Beginning at the extreme northwest of the Dominion, the first of these areas is between the eastern boundary of Alaska, the Porcupine River, and the Arctic coast, about 9,500 square miles in extent, or somewhat smaller than Belgium, and lying entirely within the Arctic Circle. The next is west of the Lewes and Yukon rivers and extends to the boundary of Alaska. Until last year, 32,000 square miles in this area was unexplored, but a part has since been traveled. A third area of 27,000 square miles—nearly twice as large as Scotland—lies between the Lewes, Pelly, and Stikine rivers. Between the Pelly and Mackenzie rivers is another large tract of 100,000 square miles, or about double the size of England. It includes nearly 600 miles of the main Rocky Mountain range. An unexplored area of 50,000 square miles is found between Great Bear Lake and the Arctic coast, being nearly all to the north of the Arctic Circle. Nearly as large as Portugal is another tract between Great Bear Lake, the Mackenzie River, and the western part of Great Slave Lake, in all 35,000 square miles. Lying between Stikine and Laird rivers to the north and the Skeena and Peace rivers to the south is an area of 81,000 square miles, which, except for a recent visit by a field party, is quite unexplored. Of the 35,000 square miles southeast of Athabasca Lake, little is known, except that it has been crossed by a field party en route to Fort Churchill. East of the Coppermine River and west of Bathurst Inlet lies 7,500 miles of unexplored land, which may be compared to half the size of Switzerland. Eastward from this, lying between the Arctic coast and Black's River, is an area of 31,000 square miles, or about equal to Ireland. Much larger than Great Britain and Ireland, and embracing 178,000 square miles, is the region bounded by Black's River, Great Slave Lake, Athabasca Lake, Hatchet and Reindeer lakes, Churchill River, and the west coast of Hudson Bay. This country includes the barren grounds of the continent. Mr. J. B. Tyrell recently struck through this country on his trip to Fort Churchill, on the Churchill River, but could only make a preliminary exploration. On the south coast of Hudson Bay, between the Severn and Attawapishkat rivers, is an area 22,000 square miles in extent, or larger than Nova Scotia; and lying between Trout Lake, Lac Seul, and the Albany River is another 15,000 square miles of unexplored land.

South and east of James Bay and nearer to large centers of population than any other unexplored region is a tract of 35,000 square miles, which may be compared in size to Portugal.

The most easterly area is the greatest of all. It comprises almost the entire interior of the Labrador peninsula or Northwest Territory, in all 289,000 square miles, or more than twice as much as Great Britain and Ireland. Two or three years ago, Mr. A. P. Lowe made a line of exploration and survey into the interior of this vast region, and the same gentleman also traveled inland up the Hamilton River, but with these exceptions the country may be regarded as practically unexplored.

The Arctic islands will add an area of several hundred thousand square miles of unexplored land.

The government, during the past year, has made a great effort in the direction of exploring and developing this vast territory. It has recognized the fact that railroads are essential to the development of a new country, and liberal inducements for their construction are made by granting millions of acres of land as a bonus.

The proposed Manitoulin and North Shore Railway has been granted 2,500,000 acres. The act awards

10,000 acres per mile to the southern end of the road as an extra inducement to the early completion of this section. The northern-end grant is at the rate of 7,500 acres per mile. The proposed road will be of great value to this part of Ontario. Stratford, for instance, will then be only 365 miles from Sault Ste. Marie, or 183 miles nearer than via North Bay, as at present; Palmerston, another railroad center, will be 332 miles distant, or 245 miles nearer; and other places in this district will likewise be favorably affected.

The opening up of the Bruce peninsula will be stimulated by the new line running its entire length to Tobermoray, which will become prominent as a railway terminus and lake port. Manitoulin Island, hitherto isolated from the rest of the world except during the season of navigation, will have the great obstacle to its development removed. The outside world seems to know but very little of this great island in the northern lakes. A prominent Manitoulin merchant, in a recent interview, made the following interesting statement about the island:

"Make no mistake about the importance of Manitoulin alone. That island, with its population of 15,000, is exporting $1,000,000 worth of products a year. That is a fraction of what may be done. We have pasture lands sufficient to raise beef stock that will eclipse in numbers and quality the output of your best three beef counties; we could raise lambs enough to supply both Toronto and Buffalo; and we could, with proper railway facilities, put Manitoulin at the head in the butter and cheese products as well.

"Then, there is all the rest of new Ontario behind this. What does that mean? Look at the Sault, which has jumped from 700 to 7,000 in a few years. And that is but the beginning. With its wealth of minerals, pulp wood, and possibilities in electrical energy developed from water power, new Ontario undoubtedly possesses wonderful resources."

The indications are that, during the next five years, at least 5,000 miles of new railroad will be completed throughout the Dominion, most of which will run through the unexplored wilderness.

The mineral wealth of this unknown region is undoubtedly immense, and perhaps almost inexhaustible; while the dense forests of hardwood, now of so little value, will, when brought to the markets of the world, become a source of large profit.—A. G. Seyfert, Consul at Stratford.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

New Pu'p Mills in Nova Scotia.—Under date of March 23, 1901, Consul Beutelspacher, of Moncton, reports the erection of new pulp mills by the Sissiboo Pulp and Paper Company, at Weymouth. The mills are practically completed, and will be running in full swing in a little more than a week. The daily output of the plant will be 30 tons, for which it is said there will be a ready sale in England. The dam which this company has built is among the largest in Canada, viz., 74 feet broad at the base, 450 feet long, and 60 feet high. The hydraulic power consists of two pairs of McCormic turbines. The company's other mill is situated at Sissiboo Falls, 3 miles above Weymouth Falls, the site of the new mills.

American Quails for Sweden.—Under date of March 14, 1901, Consul Nelson, of Bergen, reports that the import of American quails into Sweden by Count Claës Lewenhaupt, of Fosstorjo, has awakened lively interest. More than 5,000 quails, representing a sum of about $3,500, have been ordered for the spring, and still more orders are expected. The birds will be sent in cages—fifty in each cage—constructed especially for this purpose, and the best hopes are entertained as to the successful transportation. The small lot of American quails which were set free in Count Lewenhaupt's estate at Claëstrop last spring have endured the winter very well, and it appears that Sweden has good prospects of an increase in its game birds.

Turkish Demand for Silk-Weaving Machinery.—Consul Thomas H. Norton, of Harput, March 4, 1901, says the establishment of a new silk factory at Mezreh is contemplated and that the persons interested desire to secure the necessary equipment from the United States. Price lists are requested from reputable firms furnishing machines and accessories for silk weaving. The prices quoted should be net, including packing, f. o. b. New York, and must cover installations using water power, the only force economically available there. Price lists of treadmills and allied means for utilizing the power of draft animals are likewise desired. They may be sent to Mr. Norton at Harput. The machinery should be such as is best adapted for a region where skilled mechanics are practically unknown and where the question of repairs becomes a serious matter. The consul adds that the silkworm is largely cultivated in that section of Turkey and that there are two silk factories in operation—one at Mezreh and the other at Harput.

Acetylene Gas for Light-Houses.—Consul-General Guenther, under date of Frankfort, March 4, 1901, reports that at the light-house of Alterbruch, acetylene gas has been experimented with, as the strongest petroleum light proved too weak for this station. It is stated in German papers that the results were entirely satisfactory, and it is expected that acetylene gas will now be used extensively for light-houses.

Tariff on Machinery in Dutch India.—Consul Hill sends from Amsterdam, March 12, 1901, a fuller statement of the tariff of the Netherlands East Indies than was contained in his report on "American Machinery for Dutch India." The tariff rates are as follows:

Factory and steam engines, machinery; machines and tools for agricultural, factory, and steam purposes, mining and trades, and also parts thereof, if considered so by custom house officers, free.

Iron, ironware, cast, wrought, milled, or forged, not separately specified, 10 per cent ad valorem.

Improvement in Brazilian Cable Service.—Improvements of an important character, materially affecting the facility and cost of cable communication between Brazil and the United States, have been made by the Western Brazilian Cable Company. As a result of the new line opened by the Commercial Cable Company from New York to the Azores Islands, connecting with the line from Brazil via Lisbon, messages can now be sent without the delays incident to the crush of business in the London offices, which formerly had to handle all the Brazilian communications. The managers of the large coffee houses here, who use the service constantly in their business, say that the new lines have proved very beneficial. In addition to the increased facilities, an advantage has been gained in the cost of transmission. The rates have been reduced on an average 25 per cent. Formerly, the charge per word from Rio de Janeiro to New York was nearly $1.30; now, it is about $1. The average time for a word in transmission between the two places is from eighteen to twenty-five minutes. Messages have come through in twelve minutes. The company sends all messages by Lisbon and the Commercial Cable Company's line, unless another route is specified by the sender.

The consolidated company operating here under the name of the "Western Cable Company" is a union of the Western Brazilian and the Brazilian Submarine. It has three cables from Pernambuco to Rio de Janeiro, two from Pernambuco to Para, two from Pernambuco to London, and one from Pernambuco to Lisbon. Connections are made with all the important ports from Para to Montevideo. The charges per word are based on the average rate of exchange for every three months, as determined by the Brazilian government. At present it is 900 reis to the franc (19.3 cents), and if exchange remains above 11d.,* it will soon be considerably less.

The following rates may be of interest:

	Milreis.
Canada, New York City, Boston, Baltimore, Philadelphia, Washington, Chicago, and New Orleans	4.68=$1.00
Barbados	8.91= 1.91
St. Thomas	9.18= 1.96
Habana	5.45= 1.16
Trinidad	9.27= 1.98

—Eugene Seeger, Consul-General at Rio de Janeiro.

Export of Russian Butter.—Under date of March 4, 1901, Consul Mahin, of Reichenberg, reports as follows relative to the export of Russian butter:

Russia has in recent years been creating a large export trade in butter. In 1897, the export amounted to 19,081,030 pounds; in the first ten months of 1900 the export was double that quantity, being 37,729,220 pounds. The principal increase of export is in the butter product of Siberia. Butter trains, equipped with refrigerating apparatus, convey the goods to the ports of export. During the season of 1900, on petition of the association of butter producers and dealers, two special trains of twenty-five cars each were dispatched weekly loaded with butter for the Baltic ports, where, in four months, 400,000 poods (14,428,000 pounds) were delivered. The chief superiority of Russian butter consists in its low price and relatively great "keeping" quality. For these reasons, it is said, many consumers prefer Siberian to other foreign butter. It is also said to be free from adulteration of any sort.

Contamination of Prussian Rivers.—Consul-General Guenther, of Frankfort, reports, March 7, 1901, that a royal Prussian commission will probably commence its labors April 1, 1901, with a view of studying the question of keeping the rivers pure and preventing the waters from becoming injurious to the health of persons or animals. Owing to the rapid increase of industrial establishments, this question has become of great importance. Aside from the contamination of the water of rivers, lakes, etc., from throwing in solids, the influx of impure water from sewers and factories will receive attention. With reference to contamination from mining operations, the respective mining authorities have been instructed to put a stop to practices injurious to the public and to co-operate in important cases with the police authorities. Effective regulations all along the line will be established.

Cotton Growing in West Africa.—Under the date of February 20, 1901, Consul Williams reports that Elder, Dempster & Company, of Liverpool, have recently offered, through the Governor of Sierra Leone, to furnish either American or Egyptian cotton seed free of cost or freight to anyone desiring to engage in the cultivation of cotton in West Africa. They also offer a prize of £100 ($486.65) to the shipper of the first cargo of 50 tons by one of their steamers.

American Coal-Cutting Machinery in London.—Vice and Acting Consul-General Westacott, of London, under date of March 16, 1901, reports that an inquiry has been made at that office for the names of firms manufacturing American coal-cutting machinery. He requests that all replies be addressed to the United States Consulate-General, London.

* 11d. (22 cents) to the milreis = 1,000 reis.

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No. 1024. April 30.—Foreign Enterprises in Korea—*New Railway Brake in Belgium—Railroads of Colombia—*American vs. Welsh Coal—Quinine Auction in Batavia—Practical Results of Wireless Telegraphy—*Manila Cigars in Java—*Trade at Port Limon—Long-Distance Telephone Line in Germany—Amsterdam-Hawaii Parcels-Post Rates.

No. 1025. May 1.—German Commercial Activity in South America—*Electric Plants in Dutch East India.

No. 1026. May 2.—*Unexplored Canada—*Exposition of Automobiles at Brussels—Mineral Production of British Columbia—*Exhibit of Spanish Goods in Havana and New York—*New Electric and Water Works in Quebec—*Canned Meats in Bond in Germany—Cable Connections with the Madeira Islands—Amsterdam Export Company.

No. 1027. May 3.—School Gardens in Sweden—Reciprocity Treaty between Chile and Nicaragua—Opening for Electric Plants in India—Cart-Road Concession in Nicaragua—Trolley Automobile Line in Germany.

No. 1028. May 4.—Petroleum in Canada—Corn in the Netherlands—Alleged Gold Discoveries in Samoa—Exposition at Namur, Belgium—Russian Export Tariff on Wood—Steel Rails for Queensland—Locomotives and Rolling Stock for Russian Railroads.

The Reports marked with an asterisk (*) will be published in the SCIENTIFIC AMERICAN SUPPLEMENT. Interested parties can obtain the other Reports by application to Bureau of Foreign Commerce, Department of State, Washington, D. C., and we suggest immediate application before the supply is exhausted.

SELECTED FORMULÆ.

Black Leather Varnishes.—

1.	Shellac	2 pounds
	Turpentine	10 pounds
	Spirit	30 pounds

One pound of logwood extract is first dissolved in the spirit, and then 3 ounces of bichromate of potash. The shellac and turpentine are then put in.

2.	Ruby shellac	60 pounds
	Venice turpentine	2 pounds
	Sanadrac	2 pounds
	Castor oil	2 pounds
	Spirit	300 pounds
	Aniline black	10 pounds
3.	Black pitch	2 pounds
	Benzole	8 pounds

This is cheap and elastic. A little turpentine increases the latter quality.

4.	Colophony	6 pounds
	Turpentine	6 pounds
	Oil of turpentine	6 pounds
	Sandarac	12 pounds
	Shellac	24 pounds
	90 per cent spirit	180 pounds

Rub up 3 pounds of lamp black with a part of the spirit, and add to the solution.

Antiseptic Healing and Hoof Salve.—

Wool fat, dark	8,000 parts.
Ceresin	3,000 parts.
Vaseline oil, 0.885	22,000 parts.
Glycerine	2,000 parts.
Wood tar, purified	2,000 parts.
Carbolic oil, 5 per cent	1,000 parts.

White Paint for Army Leather.—

Soak

Best white glue	1,500 parts.
Gum Arabic	0.500 parts.
in water	6,500 parts.

For one day, then boil next, add 0.175 parts of acetic acid (5 per cent) and stir well. Now gradually stir in 2,000 parts of best precipitated chalk and dilute with water, according to the season, to a good working consistency.

White Paint-Polish for White Army Leather.—Reduce to small pieces:

White beeswax	1.750 parts
Carnauba wax	0.500 parts.
(and pour over this in a glass flask)	
Sulphuric ether	8,000 parts.

The bottle should be corked up well and tied up with a thin piece of leather, whereupon it is left to stand, with daily, frequent stirrings, in a moderately warm place until all has dissolved.

Parian Light White for White Shoes.—

White glue, best quality	0.500 parts.
Gum Arabic	0.500 parts.
Water	3.225 parts
Precipitated chalk, prime	0.750 parts.
Citronella oil	0.050 parts.

Preparation same as for white leather paint.

Patent Axle Oil.—

Vaseline oil, technical, white	50 kilos.
Neat's foot oil	25 kilos.
Rape seed oil, refined	25 kilos.

Heat the neat's foot oil and the rape seed oil to 50° C., stir the likewise pre-warmed vaseline oil into this and filter through blotting paper.—Seifensieder Zeitung, Augsburg.

Fly Papers.—Fly papers are of two kinds. One is a non-poisonous variety to which the flies adhere once they have alighted upon it. By their struggles to get free, the flies then smear themselves all over with the sticky compound, and getting their spiracles stopped up, perish of suffocation. The other kind contains a poison, generally arsenic, which is made palatable by means of sugar in some form, and which the flies, in imbibing the sugar, take into their stomachs with fatal results. Of course, sweet substances are added to the sticky fly papers to attract the insects.

The following are approved recipes for the poisonous variety. Those containing scheduled poisons can only be sold by chemists. The paper is impregnated with a mass made according to the recipe and then dried, being dampened when it is exposed to the flies:

a. As strong a solution of white arsenic as can be made in sweetened water.

b. A mixture of treacle, honey, or moist sugar, with about one-twelfth of its weight of King's yellow or orpiment.

c. Boil two ounces of small quassia chips in a gallon of water for ten minutes. Strain and sweeten with 2 pounds of treacle. Venice turpentine may also be added.

d. Mix together: Black pepper, 1 ounce; brown sugar, 2 ounces; cream, 4 ounces.

e. Boil 150 ounces of quassia chips with 400 ounces of water. Strain and add chloride of cobalt, 10 ounces; tartar emetic, 2 ounces; tincture of long pepper (1:4), 80 ounces.

f. Dissolve 2 ounces of arsenic or potash or soda and 4 ounces of sugar in a quart of water.

The following recipes belong to the sticky class:

a. Varnish oiled paper with turpentine varnish.

b. Fuse rosin with enough linseed oil to make it sticky.

c. Fuse rosin and mix it with sweet oil to the consistency of honey.

d. Make a mixture of fused rosin, honey and boiled oil.

e. Mix 9 pounds of fused rosin with 4 pounds of rapeseed oil. Soak the paper in alum and dry it before applying the mixture to it.

f. Fuse 16 pounds of rosin and stir in, without overheating, 8 pounds of turpentine, 8 pounds of rapeseed oil, and 1 pound of honey.

g. Boil together till thick enough: Rosin, 32 pounds; linseed oil, 7 pounds, and molasses, 7 pounds.

h. Boil together 12 pounds of rosin, 10 pounds of boiled oil, 4 pounds of honey, and 1 pound of glycerine.

By any one of the recipes an efficient papier-mouche can be prepared.

TRADE NOTES AND RECEIPTS.

Glycerin for the Toilette.—According to Fr. Toellner a fine preparation is obtained by the following receipt: Heliotropin 0.5, ionon solution 0.5, rose oil 3 drops, spirit of wine (95 per cent) 25.0. Dissolve and filter; mix the filtrate with chemically pure glycerin 1,000.—Neueste Erfindungen under Erfahrungen.

Antiseptic Mouth Water.—As a mouth wash of protracted antiseptic effect, Huchard recommends the following mixture:

Crystallized carbolic acid....	4.00 grammes
Eucalyptol	1.00 gramme
Salol	2.00 grammes
Menthol	0.25 gramme
Thymol	0.10 gramme
Alcohol	100.00 grammes

Scent ad libitum; color with cochineal.

Soap as a Dissolvent of Carbolic Acid.—After Courach had ascertained that soap possesses the quality of increasing the solubility of carbolic acid, Triolett made tests regarding the quantitative action of soap as a solvent of carbolic acid. His researches, published in the Bulletin des Sciences Pharmacologiques, have led to the following results: One liter of water containing 1 gramme of soap in solution is capable of dissolving 90 grammes of carbolic acid; with 2 grammes of soap, 96 grammes; with 4 grammes, 108 grammes. One liter of water, containing 50 grammes of soap, dissolves 600 grammes of carbolic acid; and 1.5 liters of solution is obtained, of which 100 cu. cm. = 40 grammes are carbolic acid. Hence, in order to prepare 1 liter of 1 per cent carbolic acid it suffices to dilute 25 cu. cm. of this stock solution to 1,000 cu. cm. with water. The solutions thus produced are light and transparent.

To Prevent Molding of Corks.—The evil of accumulation of mold under the capsules may easily be avoided if one is careful to put on the capsule only after the upper surface of the cork has dried completely; besides, it should not be omitted to wipe off the neck and mouth of the bottle with a clean cloth before capsuling, so as to remove all impurities which might favor the formation of mold. In the case of corks that are not faultless and do not close tightly it may, nevertheless, occur that some wine, etc., strikes through, which furthers the formation of mold immensely, especially if the capsules have not been pressed tightly against the neck of the bottle. In order to prevent in such cases the growth of mold under the capsule, the upper surface of the cork and the edge of the mouth of the bottle are coated with a solution of shellac in 96 per cent alcohol.—Allgemeine Weinzeitung.

Substitute for Celluloid, Parchment, etc.—A process for the transformation of vegetable fibers, especially cotton tissues, into a parchment-like produet has been patented in Austria. A cotton fabric, such as calico, is treated with sodium lye and carbon sulphide, the latter, however, not in the liquid but in the vaporous state. The sodium lye used for this purpose, with which the cotton fabric is worked through and then pressed out, must not exceed 25 per cent in strength. The whole is now left alone for three days in a closed receptacle and then suspended in an atmosphere of carbon sulphide vapors till it has changed into a yellowish-brown, translucent mass. The fabric is now rinsed in water; this causes it to swell; then it is pre-dried on plates; loosened from the plates, it is allowed to finish drying at 100 deg. C., whereby shrinking and a brown coloration is effected. The fabric thus hardened can be rendered pliable again by several hours' immersion on 5 per cent acetic acid, which is generally done; subsequently it is washed and likewise dried again. The product obtained in this manner consists of a firm, translucent mass, which becomes moldable and softens on being heated to 100 deg. C., so that it may be provided with any desired patterns by pressing between plates or rollers. The product may then be completely bleached by the use of chloride of lime, or may be dyed as desired. It is excellently adapted as a substitute for celluloid, parchment, gutta percha and caoutchouc.—Suedeutsche Chemiker Zeitung.

Fire-Lutes.—In order to protect vessels of glass, iron or porcelain from the direct action of the naked fire and to prevent too quick a heating, they are provided with coatings which, being poor conductors of heat, admit only of a gradual raising of the temperature and also inhibit too rapid a cooling. For glass retorts a thin paste of clay is employed into which combustible substances such as bran, hemp waste, animal hairs, etc., are incorporated. Upon heating these admixtures char and burn up and impart to the covering a certain degree of porosity. In the case of a comparatively slight coating of clay without any admixture, the heat has to be so strong that the covering glows vividly, in order to obtain a temperature of some 100 deg. C. in the interior of the vessel. In order to cause the coating to adhere well, it is diluted with water until a mass results which allows of being applied with a brush. After each coat sufficient time for a thorough drying should be allowed and the applications continued until the coating has acquired the desired thickness. Once a glass retort has withstood a high temperature, it may be employed frequently without fear of its cracking. But if cracks appear in the coating after the heating, they must be carefully filled up with the same mass. While for glass vessels the clay coating is the most commendable, the following fire-lutes are used for iron receptacles: Clay, 20 parts, brick dust, 30 parts; hammer scale, 8 parts; cooking salt, 1 part; borax, ½ part; animal hairs, 1 part, and water 3 parts. For iron retorts which are to stand very high degrees of heat the following mass is recommended: Fire clay, 15) parts; ordinary clay, 15 parts; quartz-one sand, 30 parts, and hemp waste, 2 parts. A lute which melts in strong heat, thus forming a protective coating for the iron, consists of powdered fluorspar, 10 parts; powdered glass, 20 parts, and water-glass, 3 parts. This covering is applied like paint, but has to be frequently renewed.—Metallarbeiter, Vienna.

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